

# Utah Science

---

Volume 29 | Number 4

Article 1

---

12-1968

## Utah Science Vol. 29 No. 4, December 1968

Follow this and additional works at: <https://digitalcommons.usu.edu/utscience>

Utah Science is produced by Utah State University Agricultural Experiment Station.

---

### Recommended Citation

(1968) "Utah Science Vol. 29 No. 4, December 1968," *Utah Science*: Vol. 29 : No. 4 , Article 1.  
Available at: <https://digitalcommons.usu.edu/utscience/vol29/iss4/1>

This Article is brought to you for free and open access by the Journals at DigitalCommons@USU. It has been accepted for inclusion in Utah Science by an authorized administrator of DigitalCommons@USU. For more information, please contact [digitalcommons@usu.edu](mailto:digitalcommons@usu.edu).





# UTAH SCIENCE

*Utah State University*



*Logan, Utah 84321*

AGRICULTURAL EXPERIMENT STATION • DEC. 1968 • Vol. 29 No. 4







Because **Utah Science** is an agriculturally oriented research magazine, cherry trees instead of Christmas trees are shown on this quarter's cover.

Cherries, both the sweet and the sour, are relished by birds and man. The development of two new cherry products is reported in the article, "Production and Quality of Cherry Raisins and Pickles," found on page 99.

To get the fruit from the tree to the table requires fighting disease as well as harvesting cheaply, quickly, and gently. X-disease, a virus disease of sweet cherry trees has severely damaged some orchards along the Wasatch Front. Its spread and control are described in "X-Disease in Sweet Cherries," pages 108-110.

The problems and expense of hand labor for harvesting sour cherries increases each year. New chemicals, machinery, equipment, and methods of harvesting one of Utah's major fruit crops are found on pages 111-113, "New Chemical may Aid Mechanical Harvesting of Sour Cherries."

Not to ignore another essential element of pies served during the year-end season, a story about "Apple Production in Northern Utah" is found on page 103.

## CONTENTS

	Page
Research on public land pricing policies at USU, N. Keith Roberts and Darwin B. Nielsen .....	95
Wildlife notes .....	98, 124
Now let's get it straight .....	98
Production and quality of cherry raisins and pickles, D. K. Salunkhe, H. R. Bolin, and N. Suthivanit .....	99
Mosquitoes love you? — here's the reason .....	102
Agricultural research serves nation .....	102
Apple production in northern Utah, Demetrios Agathangelides .....	103
X-disease of sweet cherries, Bryce N. Wadley and J. LaMar Anderson .....	108
New chemical may aid mechanical harvesting of sweet cherries, J. LaMar Anderson .....	111
Farm planning for weed control, D. C. Tingey .....	114
Exotic game birds in Utah's future — ecology in action, Wayne H. Bohl and Lois Cox .....	117
Caecal worm may cause chukar loss .....	123
Utah again free from hog cholera .....	124

## UTAH SCIENCE

A quarterly devoted to research in agriculture, land and water resources, home and community life, human nutrition and development, and published by the Agricultural Experiment Station, Utah State University, Logan, Utah.

The magazine will be sent free on request.

To avoid overuse of technical terms, trade names of products or equipment sometimes are used. No endorsement of specific products or firms named is intended, nor is criticism implied of those not mentioned.

Articles and information appearing in *Utah Science* become public property upon publication. They may be reprinted provided that no endorsement of a specific commercial product or firm is stated or implied in so doing.

Please credit the authors, Utah State University, and *Utah Science*.

**Glen L. Taggart, President**

**Wynne Thorne,  
Vice President for Research  
Utah State University**

**K. W. Hill, Director  
Agricultural Experiment Station**

**Millard E. Wilde, Editor**



# Research on public land pricing policies at USU

N. KEITH ROBERTS and DARWIN B. NIELSEN

This article summarizes research done at Utah State University on public land use fees and the economic impact of public land policy changes. Resource economists at Utah State University have given this research area high priority because of its importance to a public land state such as Utah.

Practically every state in the west is expending some research time on land policy issues. Financial support of these efforts has come from federal and state sources. The major federal and state land management agencies have placed considerable amounts of money in the western land grant universities to support the research discussed here. A large share of it has come to USU over the years.

Although Utah State University resource economists are not the only ones interested in the complex economic problems facing public land users and managers today, more effort has been expended at USU on public land pricing problems than anywhere else outside the federal agencies themselves. This article reviews that effort as it has developed from a beginning in the late 1950s. A bibliography at the end lists some of the research publications resulting from this work.

## UTAH STATE LAND BOARD STUDIES

The Utah State Land Board can take credit for awakening the interest of USU resource economists in public land use pricing issues. In 1959 that state agency provided a grant to investigate some of its problems.

In a report published in 1961, four fee-setting formulas or models were proposed. All were based on the idea

that range forage was worth at least as much as the *most inexpensive substitute* that would do the same feeding job for ranchers. The first fee model considered alfalfa as the substitute for range forage. The second model introduced changes in livestock prices as an adjustment to model 1. Model 3 considered Bureau of Land Management (BLM) permits as the substitute feed source. Model 4 used leasing private range as the substitute. Theoretically, the models were right but obtaining necessary data in the real world to satisfy them is at least difficult and costly, if not impossible. However, the work was a first approximation. What followed were refinements and extensions.

## BLM — USFS REGIONAL RANCHING STUDY

In 1961 the Bureau of Land Management and the United States Forest Service contracted with three western universities to help them determine the economic impact of fee and permit adjustments on ranch income. Utah State University was one of the institutions selected. The ranching population in the west was stratified by cost-determining factors. Within each stratum a representative ranch budget was constructed based on data obtained from a survey of ranchers. Then fee and permit changes were budgeted through these representative ranches.

A considerable amount of information was made available because of

•

N. KEITH ROBERTS is Head, Department of Agricultural Economics and Director, Economics Research Center; and DARWIN B. NIELSEN is an Assistant Professor of Agricultural Economics, Utah State University, Logan, Utah.

this region-wide survey. On the average, cattle ranchers realized 2.0 percent and sheep ranchers 2.6 percent return on their investment. Over half obtained between 1.0 and 3.0 percent rate of return. About one-fourth of the ranches received less than 1.0 percent or a negative return; one-fifth received over 4.0 percent.

These figures are important. Although ranchers knew that the market rate of interest was about 6.0 percent when they borrowed money, and rates were as high as 5.0 percent if they put their capital in savings, they still preferred to leave their money in the lower return investment of ranching. On the average ranchers were willing to pay from 3.0 to 4.0 percent on their capital for their "love of ranching" — or for their "fear of not ranching". These rates of return were based on current land values. Grazing fees in 1960 made up about 4.68 percent of total operating costs on cattle ranches and 2.93 percent on sheep ranches.

## ECONOMIC FOUNDATIONS FOR GRAZING FEES

During the early 1960s, the USU researchers became aware of a ranch asset known as a "permit" to use public range land. Ranchers and lending agencies in Utah had a good idea of its sale value. The permit was a cost over and above the fee charged by the public land agencies for the use of public range. Moreover, from some sections of society came the cry that ranchers were being subsidized through low grazing fees. Ranchers countered with the arguments that they could not afford fee increases, and that, after all, they or their fathers settled and developed the West



when no one else wanted it. Nearly everyone concerned felt uncomfortable about the pressures coming from all sides for fee policy changes. The agencies were in the middle trying to do what they could to "stabilize the livestock industries" and at the same time "do the greatest good for the greatest number of people" — a perplexing dilemma which existed because of various policy statements made in the past.

Several studies at USU were undertaken to provide a foundation for more meaningful debate. One tried to explain through economic logic why many of the public land use fee and management problems existed. Other studies identified "permit values" owned by ranchers. Still others explained the reasons why long-run policies had caused misallocation of range resources. All the studies tried to show that perhaps there were two sides to the controversy.

## STUDIES TO DISCOVER GRAZING VALUES

By 1964 some definite hypotheses had been formed by USU resource economists. Somehow, they needed to be tested in the real world. Again the U.S. Forest Service and the Bureau of Land Management came forward with money to help test the hypotheses. With the strength of past experience, resource economists at USU hypothesized that: (1) range markets existed; (2) permit values and prices of other non-controlled ranch inputs were market sensitive and would compensate for mispricing of forage on public lands; and (3) people in range market areas reacted to economic maladjustments the same as anyone else by trying to obtain the lower cost forage until an uneasy equilibrium was established.

Utah was used as a case to test the above ideas. Ranges were stratified by season of use, by sheep and cattle

use, and by public and private ownership. Over 600 ranchers from all over the state were interviewed, and records of total range use costs were studied. Only two ranchers refused to open their books for the survey. Many credit agency people were questioned about permit values and other pertinent matters.

When field data were collected, total rancher use costs for public ranges and similar private ranges were compared in broad "market" areas. No statistically significant differences were found between total use costs for public and similar private ranges.

Yes, private grazing fees were higher, but non-fee costs on similar public ranges were also higher. Non-fee costs included, death loss, association fees, herding, moving livestock to and from allotment, maintenance of improvements, cost of holding the permit, veterinary costs, salt and supplemental feed, depreciation of improvements,



**Figure 1.** Grazing fees charged by the U.S. Forest Service and the Bureau of Land Management for the use of public ranges by ranchers have recently come under scrutiny. These grazing permits, usually priced lower than fees charged for private ranges, are a definite asset to the ordinary ranching operation.



transport, and other costs. "Range markets" became evident as changes in permit values occurred around the state. Consistency in total use costs within "market" areas also added evidence of the existence of definable markets.

Still, this study was only a first approximation. Refinements and more tests were necessary. With a USFS grant the model was refined. Market areas were more carefully defined for forest ranges. It was determined that private vs. public-use cost differentials capitalized at about 3.2 and 3.4 percent equaled the permit sales prices in the forest range market areas in Utah. These rates are reasonable since ranchers in these same areas were willing to stay in ranching if they received between 2 and 3 percent on their investment as determined by the earlier study.

### ECONOMIC IMPACT STUDIES

Resource economists at USU began studying the economic impact of fee and grazing policies on ranchers in the late 1950s. It was soon determined that the fees charged by public land agencies made up a minor part of the total cost of ranching. However, the major impact of fee increases does become significant with respect to other economic consequences.

Since society had permitted mispricing of the public resource to exist for many, an asset had been created to adjust for the "error". That asset or permit value has become part of the capital assets owned by ranchers — just like land. The Bureau of the Budget has instructed the public land agencies that they should review their fee policies and adjust the fee levels to reflect the value to the user. This brought to the fore the question of whether the agencies should or could recognize the permit value as part of the cost of using the public land. As of this writing, this issue has not been resolved.

The Forest Service contracted with USU to determine the economic impact of alternative fee policies on

ranchers and local economies. The major alternatives considered were: (1) a fee that would stabilize the permit value over time; and (2) a fee that would eliminate the permit value.

The fee that would stabilize the permit value would recognize the permit as a cost of using public rangeland. Any fee increase would be dependent upon changes in the supply and demand conditions which would cause public grazing to become more valuable. Under this system the impact on ranchers would be minimal. Fees would only increase about \$11,000 for sheep and cattle grazing on forest ranges in Utah under this alternative. Permit values would remain unchanged.

On the other hand, if fees were increased to the full value of the forage, the impact would be much greater. Rancher income for sheep and cattle ranchers grazing forest lands would decrease \$434,000 annually. In addition to the \$434,000 increase in fees, permit values would be expected to disappear if a competitive market for grazing existed. The impact on capital structure of ranches was estimated by multiplying the average permit value per forest in Utah by the number of animal unit months (AUM) grazed. The loss in forest permit values would be about 13 million dollars in Utah. If the BLM followed the same fee

policy and charged the full value of the forage, these permit values would also be eliminated. Assuming BLM permits are worth about \$10/AUM this would amount to about 13.5 million dollars.

Individual ranchers have substantial amounts of money invested in grazing permits. Research indicates that some ranchers have over \$80,000 invested in Forest Service grazing permits alone. If the same rancher also owned BLM permits he could stand to lose well over \$100,000 in capital assets.

In addition to the above impacts of alternative grazing fee policies there are secondary impacts on other segments of the economy. Research needs to be done to accurately establish what the impacts would be.

### CONCLUSIONS

Out of the fee and impact studies at USU and other places around the West has come a better understanding of public land problems. The phrase "rancher subsidy" is not heard so often anymore since it is apparent that ranchers pay for the public range used. Ranchers understand that even though they pay for public range use, they do not pay the owning society all the range is worth. Society realizes to some extent that the mispricing is



**Figure 2.** Public owned desert ranges provide a valuable source of forage for sheep during the winter.



not the ranchers' fault, or the agencies' fault, but society's fault because of past policies. Most people accept the fact that a compensating ranch asset has been created — the permit value — which is rancher owned and paid for and can be used as collateral when obtaining loans.

Most of the research on these problems has been directed toward the economic impact of public land policy changes on users. Now USU researchers are beginning to expand their studies. They are looking at the economic impact of public land policies on communities in the state of Utah as well as the state itself.

### CHRONOLOGICAL PUBLICATIONS ON PUBLIC RESOURCE POLICY RESEARCH

- Wennergren, E. Boyd and N. K. Roberts. Decision making criteria for maximizing returns to federal grant lands. *J. Farm Econ.* Dec. 1961.
- Roberts, N. K. Managing private lands in relation to changing uses of public lands. In *Land and Water Use*. Proc. Amer. Ass. for the Adv. of Sci. 1961.
- Gardner, B. Delworth. Transfer restrictions and misallocation in grazing public range. *J. Farm Econ.* Feb. 1962.
- Gardner, B. Delworth. A program to stabilize livestock grazing on the public lands. *Nat. Wool Grower*. Nov. 1962.
- Caton, D. D., N. K. Roberts, et. al. Economic relationships of grazing fees and permitted use of public rangelands to net income of Western livestock ranches. *USDA-ERS Admin. Rep.* 1962.
- Gardner, B. D. and N. K. Roberts. Government policy and the beef industry in the West. *Proc. Nat. Beef Conf.*, Iowa State Agr. and Econ. Adjust. Center. 1962.
- Wennergren, E. Boyd and N. K. Roberts. Federal grant lands in Utah—management alternatives for maximizing economic returns to surface uses. *Utah Agr. Exp. Sta. Bull.* 437. Jan. 1963.

Roberts, N. K. and E. Boyd Wennergren. The economics of selecting and administering state lands for grazing use. *Utah Agr. Exp. Sta. Bull.* 443. May 1963.

Wennergren, E. Boyd and N. K. Roberts. Federal grant lands in Utah — obtaining maximum returns. *Utah Farm and Home Sci. Sep.* 1963.

Roberts, N. K. and E. Boyd Wennergren. The raising fees as revenue from federal grant lands. *Utah Farm and Home Sci.* Dec. 1963.

Roberts, N. K. and C. K. Gee. Cattle ranches using public ranges the year long — economic adjustments to fee and permit changes. *Utah Agr. Exp. Sta. Bull.* 440. 1963.

Roberts, N. K. Economic foundations for grazing use fees on public lands. *J. Farm. Econ.* Nov. 1963.

Gardner, B. Delworth. A proposal to reduce misallocation of grazing permits on public range lands. *J. Farm Econ.* Feb. 1963.

Roberts, N. K. and B. D. Gardner. Livestock and the public lands. *Utah Hist. Quart.* Summer 1964.

Wennergren, E. Boyd and N. K. Roberts. Determining special use fees on federal grant lands. *Utah Agr. Exp. Sta. Bull.* 452. Apr. 1965.

Roberts, N. K. and Mardell Topham. Discovering grazing values. *Dept. Agr. Econ. Ser.* 65-3. 1965.

Jensen, Bartell C. Determining grazing fees on national forests (preliminary report, U. S. Forest Service). 1965.

Roberts, N. K. and Lois M. Cox. Public land and social costs. *New Mexico Bus. J.* 1965.

Gardner, B. Delworth. The effects of resource policies on income distribution. *J. Farm Manage.* Dec. 1966.

Nielsen, D. B. Economics of range improvements — a rancher's handbook to economic decision making. *Utah Agr. Exp. Sta. Bull.* 466. Apr. 1967.

Nielsen, D. B. The potential impact of alternative fee adjustments. *Spec. Rep., Agr. Econ. Ser.* 67-1.

Roberts, N. K. Discovering grazing values. *J. Range Manage.* 1967.

Wennergren, E. Boyd and N. Keith Roberts. Managing state lands: some legal-economic considerations. *Nat. Resources J.* Apr. 1967.

Hooper, Jack T. Potential for increases in grazing fees. *J. Range Manage.* 1967.

### WILDLIFE NOTES

Almost all American game birds are "precocial." Their young are covered with down when hatched, and are able to leave the nest as soon as they are dry. Exceptions are pigeons and doves whose young are "altricial," and stay in the nest until ready to fly.

There's a strong bond between some older wild animals and young ones. Old cow elk may "baby sit" with calves while the mother elk are elsewhere. In small social groups of wolves, pups may be tended by an old female while the parents are out hunting.

### NOW LET'S GET IT STRAIGHT

Statistics concerning the youth market in this country have been repeated so often they're accepted as "gospel" in many quarters. Fact is some are NOT fact. So says the Bureau of Census of the U.S. Department of Commerce—granddaddy of all statistics keepers. Item: half the population is under age 25. Not so says the Bureau. More than half the population (106 million) is over 25. Item: average age in this country is 20 . . . or 21 . . . or 18. No. Bureau says average is closer to 28 (27.7). Item: most of the people alive today were born after the Second World War. Nope . . . most of us (56.5 percent, to be exact) were born before World War II.



# PRODUCTION AND QUALITY OF CHERRY RAISINS AND PICKLES

D. K. SALUNKHE, H. R. BOLIN, and N. SUTHIVANIT

Since the story of George Washington chopping down the cherry tree was first circulated among school children, Americans have heard of this particular type of fruit tree. Cherry trees were among the first trees brought to America by the early colonists, and they grew profusely in the New England area. By the late 1700s, nurseries offered budded or grafted cherry trees to the colonial orchardist. As the western migration occurred, cherries were introduced across the land. Even a few commercial orchards were being planted as far west as Oregon by the mid-1800s. Cherries were probably introduced into the Great Basin Area by the Mormons shortly after they pioneered the Salt Lake Valley. Since that time, Utah has become one of the top cherry producing states in the nation.

It wasn't until the early 1900s, however, that cherries were grown commercially on a large scale. By this time, methods of perserving them (chiefly canning) had been developed so that they could be processed and shipped long distances. Over the years an ever increasing percentage of the total cherry crop are processed. Today more than 60 percent of the national sweet cherry harvest and 90 percent of the sour cherry production are processed in the same manner. Canning, freezing, and brining are the main methods used, but Utah State University researchers are investigating two other methods — drying and pickling — which show great potential.

D. K. SALUNKHE is a Professor in the Food Science and Industries Department, Utah State University, Logan, Utah. H. R. BOLIN is a Food Technician for the Western Regional Research Laboratory, United States Department of Agriculture, and is working on his PhD at Utah State University, Logan, Utah. N. SUTHIVANIT is an instructor in Food Science at Kasetsart University, Bangkok, Thailand. She is presently a graduate student in Food Science and Industries, Utah State University, Logan, Utah.

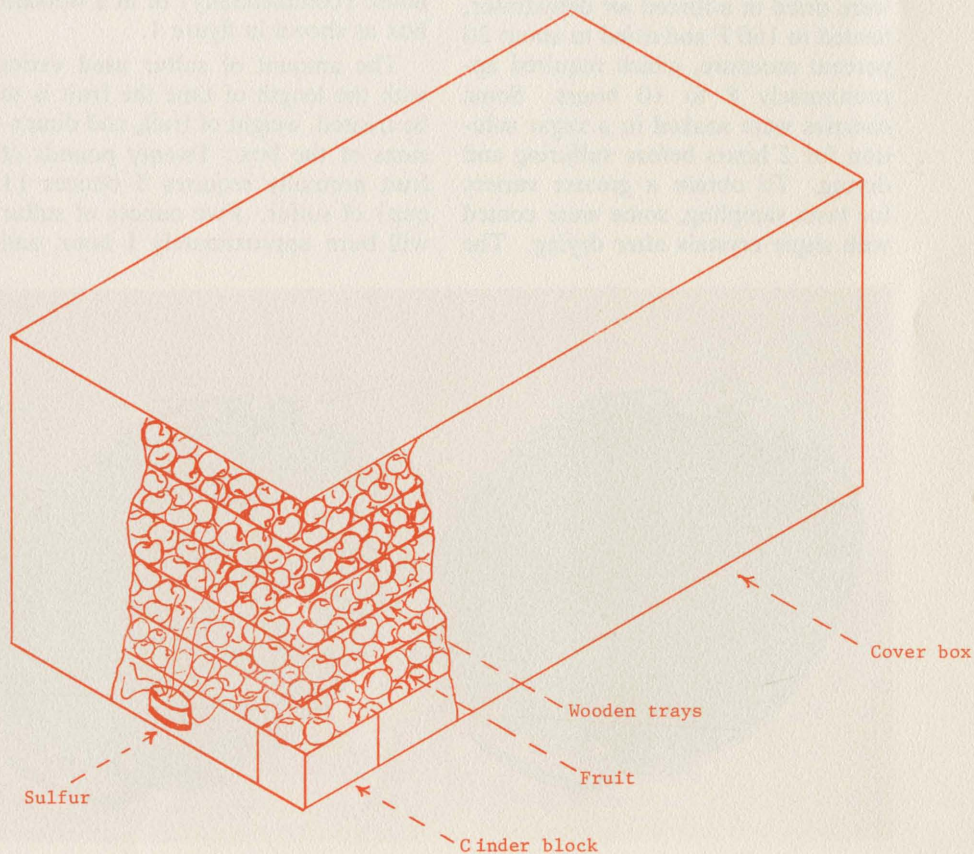
## DEHYDRATION

Drying is one of the oldest methods of food preservation. Fruits were dried in early Biblical times using only the energy from the sun. These sun-dried fruits were then stored and consumed when needed. In drying, enough moisture is removed from the fruits to retard microbial spoilage. In addition to prolonging the storage life of the fruit, drying also concentrates the fruit components. For instance, 1 pound of dried raisins is equivalent to about 4 pounds of fresh grapes, and 1 pound of dried apricots is roughly equal to 7 pounds of the fresh fruit.

Regular raisins are dried in the sun. However, a light colored golden raisin is produced by submitting the seedless grapes to the fumes of burning sulfur before dehydration. This sulfur treatment inhibits enzymatic browning during drying and maintains a light color.

## DRIED SOUR CHERRIES

Raisins have realized wide popularity and usage because they are of a convenient size, sweet, and have a good flavor. From grapes to cherries is only a small jump when one realizes that cherries also can be dried into a product that is of a convenient size,



**Figure 1.** A simple arrangement for sulfuring cherry raisins prior to drying. Five ounces of sulfur (1 cup) burned for 1 hour will adequately treat 20 pounds of fresh fruit.



sweet, and has a good flavor. In addition, cherries have a beautiful bright red color that further enhances them. Therefore, dried cherries should have a terrific potential.

From the growers' point of view, this would supply an additional outlet for the fruit he produces. Cherries for drying could be easily mechanically harvested because slight abrading would not affect the appearance or quality of the final product. This fact alone would reduce considerably the cost of the fresh cherries for drying. The dehydration process can be easily mechanized so a minimum of hand labor is required, such as evidenced by the prune dehydration operations of California.

For this study pitted Montmorency sour cherries, which were obtained commercially, were dipped for 4 minutes in a 2-percent bisulfite-citric acid solution. These cherries were then treated by exposing them to burning sulfur fumes for 1 hour. They then were dried in a forced air dehydrator, heated to 160 F and dried to about 20 percent moisture, which required approximately 8 to 10 hours. Some cherries were soaked in a sugar solution for 2 hours before sulfuring and drying. To obtain a greater variety for taste sampling, some were coated with sugar crystals after drying. The

dried products were sealed in plastic bags and held for evaluation.

### HOME PROCESSING

Actually, the process of drying cherries is so simple that most housewives could accomplish it with a little extra planning and maybe some help from the man of the house. It is important that only fully ripened cherries be used for drying. Remove any defective cherries. Wash, pit, sulfur, and spread on trays in a single layer so the moisture will evaporate more quickly and uniformly.

Pitted cherries will darken, lose flavor and vitamin C, and have highly unappetizing appearance if not treated immediately before drying. To prevent these objectionable reactions, the cherries should be sulfured. Only sulfur free of impurities will burn properly. Pure sulfur can be purchased at any drug store. Sulfuring must be conducted outdoors in a sulfur house (commercially) or in a wooden box as shown in figure 1.

The amount of sulfur used varies with the length of time the fruit is to be treated, weight of fruit, and dimensions of the box. Twenty pounds of fruit normally requires 5 ounces (1 cup) of sulfur. Five ounces of sulfur will burn approximately 1 hour, and

cherries require approximately 1 hour sulfuring. Sometime sulfuring is a cumbersome process; hence fruits are dipped in an acidified sodium bisulfite solution. The concentration of the solution should be 2 percent sodium bisulfate-citric acid. This solution can be made by adding 3 to 4 tablespoons each of sodium bisulfate and citric acid to each gallon of water required. Soak pitted fruits for 1 to 2 minutes and then drain them out and spread on the trays.

To adjust to the proper sugar-acid ratio, the cherries may be soaked in a 70-percent sugar solution for an hour or two prior to drying or granulated sugar may be added subsequent to the drying operation.

The treated cherries then can be dried in the sun, in the oven, or in home-made driers. When using an oven, the drying temperature should be 150 F to 160 F for about 8 to 10 hours until 80 percent of the moisture is removed. To dry evenly, rotate the trays.

Pack the dried fruits in airtight and moisture-proof containers and store them in a dry cool place away from light.

### FERMENTATION

Throughout the ages, at least since Noah, men have used fermentation to



**Figure 2.** Sour cherry raisins dried at the Utah Agricultural Experiment Station. On the left are the plain raisins and in the middle are those sprinkled with granulated sugar after drying. Those on the right were soaked in a 70-percent sucrose solution for 2 hours before drying. All were sulfured. The sucrose treated raisins retained the brightest color.



preserve certain foods or create new food products. Wines are probably the best known example, but other common items familiar to American palates are pickled cucumbers and olives.

Cucumber pickles can be prepared by various procedures which essentially consist of packing the fresh cucumbers in a saline solution containing vinegar and salt. During storage fermentation occurs that produces the desirable qualities in the cucumber that American consumers have come to appreciate.

Olive production is slightly different. The fresh olives are submitted to a preliminary sodium hydroxide (lye) treatment for about 2 days. After this, the olives are soaked in a salt solution and fermentation is allowed to occur. After the fermentation has reached completion, the product is ready for consumption.

Many other products are preserved by pickling. These include sauerkraut, onions, cauliflower, beans, carrots, and beets. One area that has not been investigated appreciably, however, is pickled fruit. Cherries should be an ideal fruit to be preserved in this respect because of their bright color, small size, and long stems.

**Table 1. Composition of Bing and Lambert pickling solutions (percent)**

Ingredients	Batch				
	1	2	3	4	5
Vinegar	59	58	55	58	55
Water	40	39	37	39	37
Sugar	----	2.5	7	2.5	7
Sodium chloride or Calcium chloride	1	1	1	1	1
Spice	----	----	----	*	*

Note: \* = 0.07 ounce per quart

### PICKLED SWEET CHERRIES

Bing and Lambert cherries were picked, graded, washed, and packed in quart jars at the rate of about  $\frac{3}{4}$  pound per jar. The various pickling solutions (table 1) were prepared, warmed, and poured over the fresh cherries. In preparing one batch, the pickling solution was heated to 160 F before pouring over the cherries. The jars were next sealed and stored at ambient (room) temperature.

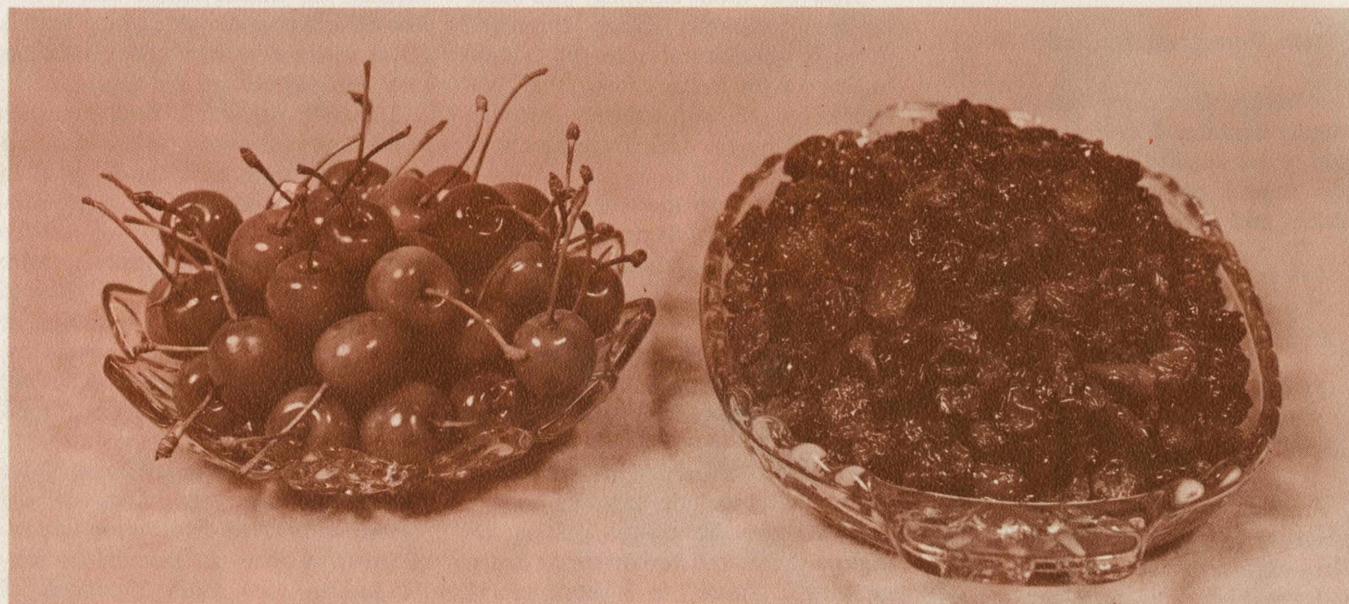
In both fermented fruits and vegetables, lactic acid bacteria produce lactic acid from sugars. It is important to maintain conditions which help the growth of the lactic acid bacteria and help avoid the growths of other

organisms which may cause spoilage of the pickled products. This is especially important when processing fruits.

### FOR HOME MADE PICKLES

For successful home manufacture of fermented pickles, the following points need to be considered:

1. Keep air from fruits during all the stages of processing. Keeping air out will prevent growth of spoilage organisms that need air to grow.
2. Keep the temperature of the pickling process as near 70 to 80 F as possible.



**Figure 3.** Pickled sweet cherries and sweet sour cherry raisins are two of the latest food products to come for USU food technology laboratories. The raisins can be used in cakes, cookies, and breakfast foods or for just plain snacks. The pickled cherries can be served much as olives with dinners, snacks, and drinks.



3. Use the correct salt, vinegar, and sugar concentration. The concentration of the solution should contain 5 tablespoons salt, 6 cups vinegar, 4 cups water, and 3 cups sugar. This brine, vinegar, and sugar concentration is high enough to inhibit growth of spoilage organisms but will permit lactic acid bacteria to grow satisfactorily.
4. Heat the solution to 120 to 150 F.
5. Add approximately  $\frac{1}{2}$  teaspoon of mixed pickle spices per pint, if desired.
6. Pour the hot solution on the cherries and store them at cool (70 to 80 F) temperature. The pickles will be ready in 1 month.
7. Heat the full jars after 1 month to inactivate the fermentation organisms.

Use glass jars with rubber ring metal lids. Do not use zinc screw caps, because the zinc salts formed with vinegar are poisonous.

Some additional hints:

**Salt:** Pure granulated salt (NaCl).

**Vinegar:** Use cider vinegar which usually contains 4 to 6 percent acetic acid. Poor quality vinegar may contain copper or iron which discolors pickles and gives off-flavor.

**Spices:** Use whole spices if desired.

**Sugar:** Use granulated sugar.

**Firming agents:** Calcium chloride or alum can be used in minute quantities.

**Fruits:** Select firm-ripe Bing or Lambert cherries with stems intact. They should not be green or overripe and should be free from bruises and blemishes.

**Water:** Water containing iron may cause pickled cherries to discolor.

## HERE'S THE REASON . . .

# MOSQUITOES LOVE YOU?

Some people may be bothered by mosquitoes more than others because their skins produce more lactic acid, U.S. Department of Agriculture scientists report.

Chemists Fred Acree, Jr., and Dr. Ralph B. Turner, while working with Agricultural Research Service entomologists Harry K. Gouck and technician Nelson Smith, at the ARS laboratory, Gainesville, Florida, recently identified the attractant after a 10-year search. Dr. Morton Beroza, ARS chemist stationed at Beltsville, Maryland, also participated in the study.

Isolation and chemical identification of the attractant makes possible testing of its potential usefulness as a lure to draw mosquitoes to traps. Mr. Acree and Dr. Turner isolated lactic acid from the arms of the Gainesville laboratory staff by washing their arms with acetone and mak-

ing chemical analyses of the washings. The scientists found that station members who had the most lactic acid on their skin also attracted the most mosquitoes. Carbon dioxide, which is also produced by the skin, is necessary for the lactic acid to be attractive but is not itself attractive.

The effects of lactic acid on mosquitoes depended on its form. The *L* isomer attracted mosquitoes five times more strongly than did the *D* isomer, the scientists said. Very small quantities — 10 micrograms of *L*-Lactic acid (plus carbon dioxide) attracted up to 75 percent of caged yellow-fever mosquitoes within 3 minutes.

The scientists said that lactic acid occurs on human skin as a natural constituent of sweat. It is an end product of animal muscle metabolism and is sometimes called sarcosolactic acid.

## AGRICULTURAL RESEARCH SERVES NATION

How our food, clothing, and shelter are constantly being improved through agricultural research is told in *Science for Better Living*, the 1968 Yearbook of Agriculture, recently published by the U.S. Department of Agriculture.

The preface to the 432-page book points out that all of us benefit in our daily lives from agricultural research "because it improves the meals we eat, the clothes we wear, our water and air, the wood we build much of our homes with, and the plants and trees that make our surroundings more livable."

Research developments which the book reports include breeding bees to pollinate specific crops, oblong tomatoes to cut tomato harvesting costs, growing a "forest" in 3 years, use of plants as air pollution detectives, new techniques in frozen foods, effective methods for stopping crabgrass, improved cotton seersucker, better orna-

mentals for homeowners, and a new low-calorie cheese. One of the book's 83 chapters tells how space satellites may help farmers of the future.

Dramatic, readable case histories of research achievements are featured in the Yearbook, which is designed to help farmers, suburbanites, city dwellers, and students. The bulk of the chapters are written by scientists who work in laboratories at USDA and other Federal and State agencies, at universities, or in private industry. There are over 250 photographs, including a color section with 53 photos.

Senators and Congressmen have limited numbers of copies of the Yearbook for free distribution to constituents. Copies of "Science for Better Living," the 1968 Yearbook of Agriculture, may also be obtained for \$3 each from the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402.



# APPLE PRODUCTION IN NORTHERN UTAH

DEMETRIOS AGATHANGELIDES

Apples are one of the leading fruit crops in Utah. Most fruit tree plantings are on the decline except apples. It is estimated that by 1970 there will be more producing apple trees than

trees of any other fruit. The leading variety is Red Delicious — 173,307 trees; followed by Jonathans, 53,619 trees; Romes, 48,075 trees; and others, 25,590.

In 1965 peach trees were the most numerous — 302,084. Apple trees totaled 300,591. Sweet cherries followed with 178,723; sour cherries, 157,266; pears, 110,823; apricots, 66,751; and prunes, 19,214.

Jonathans and Romes are in a sharp decline because consumer demand is lacking. These varieties are being replaced by Red Delicious and Golden Delicious. Golden Delicious are excellent dessert apples and they also serve as good pollenizers for Red Delicious. Orchardists also are showing an increased interest in summer apples.

Even though Jonathans are in second place (table 1), Golden Delicious will probably replace them in the near future. In number of *new* trees it would rank second or third now. The varietal picture has been changing in the United States too. Golden Delicious has come to the fore in a period of 25 years. In 1942 it ranked seventh. Now it ranks third.

Most Utah apple production is centered in the northern part of the state. Utah county produces more apples than all the other counties combined. Utah county producers now have plans underway to build a new modern packing shed.

In 1954 there was a total of 120,214 apple trees in Utah county, but by 1965 there were 222,901 trees. Box Elder and Grand counties more than doubled their number of trees in the same period.

## WEATHER PROBLEMS

There is a need for quality apples in Utah, and Northern Utah has the

•  
DEMETRIOS AGATHANGELIDES is a Research Assistant, Plant Science Department, Utah State University, Logan, Utah.





land and climatic conditions required to produce such apples. The spring temperatures are low enough that full bloom does not come until the 15th or 20th of May in Cache Valley. The

Provo and Orem areas may be a week or 10 days earlier. Although killing frosts often occur during the blossom period, most orchardists can raise

temperatures to a safe level by heating.

When full bloom occurs near the middle of May, the apples are usually picked the first part of October (145 days after full bloom. The average maximum temperatures during September and October are 74 F and 64 F, respectively, and the minimum temperatures for the same months are 47 F and 39 F, respectively. These low night temperatures and warm, but not excessively hot, days contribute to good fruit color and flavor.

**Table 1. Leading varieties of apples and number of trees by age categories in Utah — 1965**

Varieties	Under 5 years	5 to 10 years	10 to 20 years	Over 20 years	Totals
Delicious	44,232	49,765	49,253	30,057	173,307
Jonathans	6,405	12,808	11,032	23,374	53,619
Romes	10,086	14,361	11,355	12,273	48,075
Others	4,288	3,769	7,455	10,078	25,590
Totals	65,011	80,703	79,095	75,782	300,591

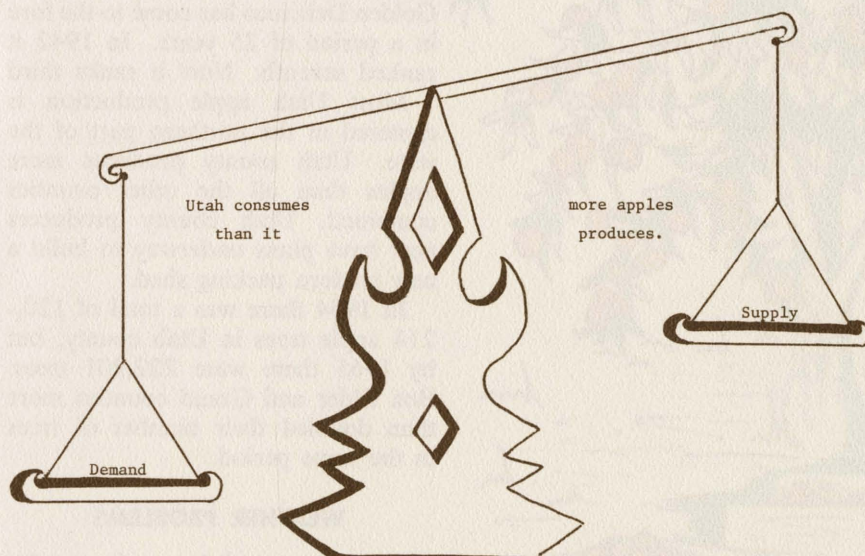
**Table 2. Sales of quality apples from Utah and the Northwest displayed in four Salt Lake City stores**

Display identification at store	Pounds of apples sold in a 21-day period	
	Utah	Northwest
1. Utah apples next to Northwest apples (labeled)	5103	4955
2. Northwest apples (labeled)	-----	8160
3. Utah apples (labeled)	7670	-----
4. Utah apples next to Northwest apples (no label as to the state of origin)	4827	4527

## PRODUCING QUALITY APPLES

Some Utah locations have the desired soil and climatic conditions to produce the finest quality apples; but after a successful growing season, the fruit grower is not insured of a profitable crop. There are other factors which will determine his economic success.

Apples should be taken to cold storage the same day they are picked. Cold storage extends the "eating life" of the apple, but Utah is suffering from a shortage of these storage places. Orem and Salt Lake City have recently built some cold storage units, but growers still lack enough space. Shortage of cold storage has caused many farmers to sell their fruit early in the season. This practice floods the market and forces down prices. Moreover, most of Utah's apple crop is sold by January and the rest of the year apples are imported from neighboring states. Consumers then pay premium price for these imported apples which total about \$1 million per year. From 1963 to 1966 a total of 753 carloads of apples were unloaded in Utah, of which 587 carloads came from Washington. These 753 carloads sold for nearly \$3.5 million. If this income were received by Utah apples growers, the whole state would benefit greatly.



**Figure 1.** Lack of cold storage space is one of the reasons why many Utah apple growers sell their fruit early in the season, flooding the market and forcing down prices. The rest of the year we import apples at premium prices from other states, chiefly the Northwest.

## PACKAGING — AN EXPENSIVE OPERATION

Another factor in presenting consumers with quality apples is the packing operation. An attractively



packed carton of apples appeals to the retailer as well as the customer. A quality pack does not only mean an eye appealing container, but also appealing contents. The packaging industry has developed many new kinds of equipment, containers, and packaging materials to keep the apples in good condition until they reach the consumer.

A large grower can carry out most of these storage, packing, and selling operations. This cannot be done by the smaller growers, however. A grower with small acreages cannot afford to have his own cold storage, packing shed, and marketing set up. Never-the-less, a co-op could solve some of these problems. By forming a co-op smaller operators would then be able to bring their quality apple in the co-op storage or packing shed. Their specialized packer and salesman could then sell a quality apple for more money than the growers could by themselves.

#### UTAH VS NORTHWEST APPLES

Utah could sell many high quality apples if they were handled properly. Dr. Ellis Lamborn, formerly of the Agricultural Economics Department, compared Northwest and Utah apples by selecting four stores in Salt Lake City. There was one display at each store at one time. All displays were set up at each store (table 2).

Dr. Lamborn concluded that: (1) The consumers paid no attention to the origin of the apple if the quality was the same. (2) Utah retailers prefer Northwest apples mainly because of better packaging. (3) Utah apples in some cases were better quality because the cold storage was closer to the market and the Northwest apples lost some of their quality from bruising in transit. (4) We are close to markets that demand more apples than we are producing.

#### APPLE ROOTSTOCKS

Dwarf apple trees are becoming more important every year as the industry develops new machinery for dwarfed orchards. There are several reasons for this interest in dwarf trees.

Pruning, spraying, and picking operations cost less on small trees. In addition, dwarf trees come into production earlier.

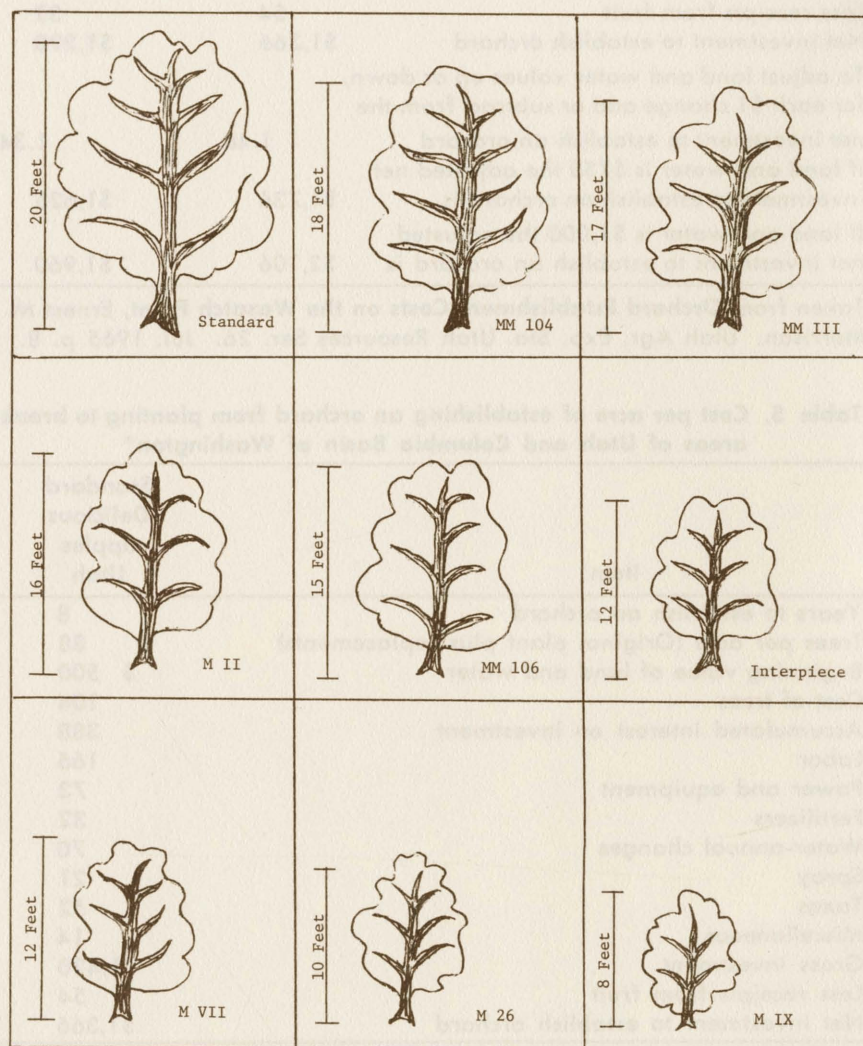
Several methods are used to produce dwarf trees. The most common

method is to use size-controlling rootstocks. More fruit trees are dwarfed on size-controlling rootstocks than by any other method.

Spur type strains or varieties also are grown. Some varieties or strains

**Table 3. Size-controlling root stocks**

Size	Type rootstock	Comparative size
Very dwarf	M IX, M 26	1/4 the size of a standard tree
Semi-dwarf	M IV, M VII, MM 106, Interstem piece	1/2 the size of a standard tree
Semi-standard	M I, M II, MM III, MM 104, spur type	2/3 the size of a standard tree
Standard	M XXV, seedling	Full size



**Figure 2.** The relative heights of standard apple trees and trees grafted to the various dwarfing rootstocks.



**Table 4. Cost per acre of establishing an orchard from planting to break-even production in the Wasatch Front areas of Utah\***

Item	Standard Delicious apples	Semi-dwarf Delicious apples
Years to establish an orchard	8	6
Trees per acre (original plant plus replacements)	88	89
*Beginning value of land and water	\$ 500	\$ 500
Cost of trees	104	114
Accumulated interest on investment	388	279
Labor	166	228
Power and equipment	73	61
Fertilizers	32	21
Water-annual charges	70	36
Spray	21	41
Taxes	52	29
Miscellaneous	14	13
Gross investment	1,420	1,322
Less receipts from fruit	54	32
Net investment to establish orchard	\$1,366	\$1,290
To adjust land and water values up or down, for each \$1 change add or subtract from the net investment to establish an orchard	1.48	1.34
If land and water is \$750 the adjusted net investment to establish an orchard is	\$1,736	\$1,625
If land and water is \$1,000 the adjusted net investment to establish an orchard is	\$2,106	\$1,960

\*Taken from **Orchard Establishment Costs on the Wasatch Front**, Ernest M. Morrison. Utah Agr. Exp. Sta. Utah Resources Ser. 26. Jul. 1965 p. 8.

produce a mass of spurs along their main branches. Usually these types of trees grow only about two-thirds the size of a standard fruit tree when budded on a seedling.

Seedlings of standard varieties can be used for dwarfing purposes if grafted with dwarfing interstocks which are usually M VII or M IX. The desired variety is placed or grafted to this interstem. Another method is to treat standard trees with growth retardants.

Different rootstocks with different size-controlling effects exist. The most common rootstocks are shown in table 3. The Malling-Merton (MM) Series is a more recently developed rootstock. Most MM rootstocks are wholly aphid resistant and better anchored, with the exception of M 26.

Utah State Agricultural Experiment Station personnel are evaluating different rootstocks and varieties for the fruit growers of the state. Because of the continuous interest for Utah Fruit growers in the dwarfing rootstocks, Dr. Ernest M. Morrison of the Agricultural Economics Department, conducted a study of the costs for

**Table 5. Cost per acre of establishing an orchard from planting to break-even production in the Wasatch Front areas of Utah and Columbia Basin of Washington\***

Item	Standard Delicious apples Utah	Semi-dwarf Delicious apples Utah	Full dwarf Delicious and Golden Delicious apples — Washington
Years to establish an orchard	8	6	3
Trees per acre (Original plant plus replacements)	88	89	408
Beginning value of land and water	\$ 500	\$ 500	\$ 500.00
Cost of trees	104	114	571.20
Accumulated interest on investment	388	279	347.74
Labor	166	228	757.34**
Power and equipment	73	61	-----
Fertilizers	32	21	-----
Water-annual changes	70	36	30.00
Spray	21	41	-----
Taxes	52	29	18.00
Miscellaneous	14	13	-----
Gross investment	1,420	1,322	2,224.28
Less receipts from fruit	54	32	292.50***
Net investment to establish orchard	\$1,366	\$1,290	\$1,931.78

\*Based on establishing a 15-acre apple orchard on full-dwarfing rootstock on a 150-acre diversified farm.

\*\*In the Columbia Basin labor costs include picking the fruit, fertilizer, rodent control, spray, etc.

\*\*\*Value of the crop was based on processing prices due to lower quality in initial years of establishment.



establishing an orchard of standard and semi-dwarf trees (tables 4 and 5).

Similar studies were conducted by the personnel of the Washington Experiment Station (table 6). In both states, the cost of establishing standard and semi-dwarf apple orchards were similar.

Washington State University Experiment Station made a second study which included the cost of establishing a dwarf orchard. The cost for the first year of the dwarf orchard was almost double a standard orchard. Planting distances vary according to rootstock, soil fertility, and texture, planting system as Hedgerow system, Rectangular system, and Square system. Planting distances vary from 4' x 16' to 30' x 30'. It is a common practice to plant semi-dwarf or semi-standard type trees with fillers which can be removed and planted out to other areas. Removal of fillers can be done after the trees start crowding. With a dwarf orchard, however, some income can be expected in the third year as compared to a standard orchard where 8 years are required before it comes into production.

#### THE FUTURE APPLE

The new rootstocks and new models of orchard machinery may brighten the future of the apple industry in Utah. Several facts bolster this assumption: (1) More apples are consumed in Utah than are produced. (2) Utah growers can supply a better quality apple to the store, since Northwest apples lose some quality in transit. (3) We are closer to the Los Angeles and other southern markets than the Northwest. (4) Northwest apples incur transportation expenses. (5) Apples are not as perishable as stone fruits. With the new cold storage methods, apples can be kept for many months. They are good quality in May. (6) The frequency of below-freezing nights is less in  
(continued on page 124)

**Table 6. Summary of establishment costs per acre apple trees on full-dwarfing rootstock\* Columbia Basin, Washington — 1966\*\***

Item	First year \$	Second year \$	Third year \$
Land preparation	1.16	-----	-----
Tree location (7' x 14')	20.38	-----	-----
Trees (400 x \$1.40)	560.00	11.20	-----
Dig holes, plant, water	23.47	4.55	-----
Planting costs	605.01	15.75	-----
Prune, train, brush removal	7.00	50.00	44.00
Rodent control	10.54	10.54	10.54
Fertilize	-----	6.34	6.64
Irrigation — corrugate	10.98	9.42	9.42
— labor	31.50	31.50	31.50
Cultivation	8.79	8.79	6.28
Weed control	43.75	12.17	12.17
Pest control	-----	5.69	24.08
Trellis	-----	175.75	3.84
Thinning	-----	-----	12.25
Cover crop	-----	-----	-----
Growing costs	112.56	310.20	160.72
Picking	-----	-----	65.00
Hauling, bin distribution	-----	-----	52.00
Supervision	-----	-----	4.00
Cleanup	-----	-----	3.50
Harvest and cleanup	-----	-----	124.50
Taxes	6.00	6.00	6.00
Water	10.00	10.00	10.00
General overhead	3.00	10.00	10.00
Interest on operating capital	2.00	7.00	7.00
Total cash and labor costs	738.57	358.95	318.22
Depred. of equip., bldgs.	13.94	27.55	41.04
Int. on equip., bldgs., land	36.12	42.38	47.30
Int. on accum invest. (6%)	-----	47.32	75.89
Total annual costs	788.63	476.20	482.45
Yield — tons per acre	-----	-----	5.85
Crop value (@ \$50 per ton***)	-----	-----	292.50
Annual income	— 788.63	— 476.20	— 189.95
Accumulated investment	788.63	1,264.83	1,454.78

\*In the Columbia basin labor costs include picking the fruit, fertilizer, rodent controlling, spraying, etc.

\*\*Based on establishing a 15-acre apple orchard on full-dwarfing rootstock on a 150-acre diversified farm.

\*\*\*Value of the crop was based on processing prices due to lower quality in initial years of establishment.



# X-DISEASE OF SWEET CHERRIES

BRYCE N. WADLEY and J. LAMAR ANDERSON

Sweet cherries are a profitable crop in those areas where they can be grown successfully. Diseases, insects, and adverse weather conditions often limit the production of sweet cherries in many orchards. Some of the serious diseases, such as brown rot, cherry leaf spot, and bacterial canker in humid areas, seldom cause trouble in the arid western states. However, virus diseases, such as x-disease, often cause high losses of fruits and trees throughout the intermountain fruit area. X-disease has become a serious problem in sweet cherries growing along the Wasatch Front in northern Utah.

## X-DISEASE

Studies at the Utah Agricultural Experiment Station in cooperation with the United States Department of Agriculture indicate x-disease virus causes serious decline of sweet cherry orchards, often with complete destruction of plantings within 3 to 6 years after the virus becomes established.

In addition, many trees are lost each year from other causes, such as girdling by insects, rodents or root rotting fungi. Improper applications of weed chemicals and fertilizers cause injuries that allow invasion and killing by wood rotting fungi.

X-disease was first described in 1933 as a disease of peaches in Connecticut. Because it could not be identified with any other known peach disease and because of its unknown relationships, it was designated "X". This disease was later found in the western United States, but because of differences in natural spread, it was considered a different strain and called "western x-disease." The differences in spread may have resulted from different insect vectors, and there may be greater differences among strains of western x-disease than between x-disease and western x-disease. In any case, x-disease virus is now considered to be the cause of the different diseases.

## ECONOMIC IMPORTANCE

Many orchards in the Western States have been eliminated and others reduced in productivity as a result of invasion by x-disease virus. In Utah many orchards from 10 to 40 years old in Box Elder, Weber, Davis, Utah, and Salt Lake counties have been eliminated 3 to 6 years after infection. One grower in the North Ogden area will lose an estimated 500 trees in 1968, while two adjacent plantings have been virtually eliminated in the past 5 years and another nearby planting is becoming diseased. Other areas with similar tree losses are located in Fruit Heights in Davis County, in Orem and Mapleton in Utah County, and near Brigham City in Box Elder county.

When one considers that it takes 8 to 10 years from planting for sweet cherry trees to reach economic production levels and that mature trees should live 40 to 50 years producing up to 1000 pounds of fruit per tree each year, the losses become tremendous. In some areas the trees which die are replaced by housing developments and in others, the growers are forced to move to less desirable growing areas.

## NATURAL SPREAD

Natural spread of x-disease virus appears to fluctuate in cycles over the years. Natural spread was rapid in peaches in Utah orchards in the 1940s, but has been relatively slow since 1950. In sweet cherries, natural spread has been rapid within orchards, but slow between them. This



**Figure 1.** On the left is a young sweet cherry tree inoculated with x-disease virus. On the right is an uninoculated control.

BRYCE N. WADLEY is a Research Plant Pathologist, Crops Research Division, Agricultural Research Service, United States Department of Agriculture, Logan, Utah, and J. LAMAR ANDERSON is an Associate Professor, Plant Science Department, Utah State University, Logan, Utah.



indicates the probability of a different vector in sweet cherries than was responsible for the rapid spread in peaches earlier. Rapid natural spread in Utah orchards has been associated with the presence of infected sweet cherry trees growing on mazzard roots. Natural spread in experimental plots has been most rapid to chokecherries, followed by sweet cherries and peaches. Spread has been slow in sour cherries.

### INSECT VECTORS

At least 10 species of leafhoppers have been identified in different areas of the United States as vectors of x-disease virus. Of these, at least seven are present and related species of the others have been found in Utah orchards. The vectors generally are inefficient. None has been found that can transmit the virus until at least 20 days after it has begun feeding on diseased trees. Even then, transmission is erratic. Some leafhoppers appear to be more efficient than others and some reproduce on sweet cherries and on chokecherries. Some appear to be "local vectors" in that they move only short distances in the orchard and do not invade nearby orchards until forced to move from dying trees.

### OTHER HOSTS OF X-DISEASE VIRUS

X-disease virus infects other plants of the genus *Prunus*, including peach, apricot, almond, nectarine, sour cherry, chokecherry, some plums, and some ornamental and wild *Prunus* spp. Milkweed has been found naturally infected and tomato, parsley, tobacco, periwinkle, and celery have been infected through the use of dodder.

Many chokecherry plants are infected throughout the United States. This plant is considered the bridging host for the virus from east to west and is the primary source of the virus in many areas. Chokecherry is abundant in the mountains of northern Utah and is often found in and near sweet cherry plantings. Infected

chokecherries appear to be the original source of the virus because infected sweet cherry trees often appear first in orchards adjacent to infected chokecherries.

Peach trees often are seriously damaged by x-disease, although trees are seldom killed. Such trees decline in productivity over a period of several years. Severity of infection in peaches is often determined by the strain of the virus. Infected peach trees often are associated with nearby infected sweet cherry trees growing on mazzard roots.

### SYMPTOMS OF X-DISEASE IN SWEET CHERRIES

X-disease virus moves slowly in sweet cherry trees, but does not move into mahaleb rootstocks, commonly

used for the propagation of sweet cherry trees. Trees propagated on mahaleb roots wilt and usually die within one year after infection. Such trees that survive more than 1 year develop symptoms of decline the following seasons. Trees that survive until the second season may produce leaf symptoms in a few small branches and any fruits on such trees are usually small and of poor quality.

Sweet cherry trees propagated on mazzard, a sweet cherry rootstock, do not wilt and die when they become infected. Leaf symptoms appear the second year after infection in Utah orchards as rosetted foliage, small leaves with serrate and wavy margins and enlarged persistent stipules. Utah orchards are the only locations in the country where enlarged persistent



**Figure 2.** This sweet cherry tree was killed by x-disease virus. Note the withered leaves and fruits still attached.





**Figure 3.** The results of x-disease in a North Ogden sweet cherry orchard. The photo was taken in August 1968.



**Figure 4.** Bing sweet cherries topworked on mahaleb rootstock are resistant to x-disease when the spread is not too rapid.

stipules have been associated with x-disease virus infection. Fruits produced on infected branches are usually small and pointed and they lack normal color and fail to mature properly. Such fruits lack sweetness and tend to be bitter. Fruits produced on branches that do not show leaf symptoms are usually normal.

Although trees propagated on mazzard rootstocks do not wilt and die, they decline progressively as the virus moves slowly through their branches. *Cytospora* fungus frequently invades such weakened trees and causes dieback.

#### CONTROL RECOMMENDATIONS

Removal of infected trees has been recommended to control x-disease in Utah orchards. Such removal will keep the numbers of infected peach and sour cherry trees at a low level. However, removal of infected sweet cherry trees, although highly recommended, has not stopped natural spread. This is probably the case because infected sweet cherries growing on mazzard roots seldom can be detected until 2 or 3 years after they become infected.

*(continued on page 113)*



# New chemical may aid mechanical harvesting of sour cherries

J. LAMAR ANDERSON

In 1967 Utah's fruit growers harvested 6,600 tons of Montmorency sour cherries. In 1968 the yield was about 20 percent less than this amount because of winter injury to the cherry buds. Essentially all of the sour cherries, also called tart or pie cherries, are used by local processing industries. The majority are fresh frozen and eventually consumed in the form of cherry pie.

In contrast to other fruit crops, only one variety of sour cherries, Montmorency, is grown commercially. Utah's cherry growers produce a high quality crop and its processors convert this into an equally high quality product for which there is a ready market. About 160,000 Montmorency cherry trees are currently in production in the state, better than half the amount growing in Utah county. Sour cherry production has nearly doubled the past 14 years in spite of erratic yields. Utah growers are continuing to increase their sour cherry acreages because of the promising future of this industry.

## FRAGILITY PROBLEMS

The mature sour cherry is a delicate fruit and must be handled with care from harvesting through processing to obtain a high quality product. Like other fruit, if sour cherries remain in the orchard very long after harvesting, they begin to heat and rapidly lose their quality. Their metabolic rate is temperature regulated

and at higher temperatures the fruit softens and its pigments and sugars are degraded. Some bruising is inevitable during harvest whether the cherries are picked by hand or machine. Quick cooling is especially critical for bruised cherries since the red pigment of the skin from the bruised area oxidizes readily and a bright red firm cherry becomes a brown soft fruit.

To minimize losses in quality, many growers transport their cherries to processing plants in bulk tanks containing water at 50 F or lower. The cold water bath immediately after harvesting accomplishes two things. First, it prevents heating with the subsequent discoloration. Second, and equally important, cooling firms the cherries so that the flesh isn't torn loose with the pit during the pitting

operation. Water cooling and transportation are especially important when cherries are harvested mechanically.

## CHEMICAL AID FOR MECHANICAL HARVESTING

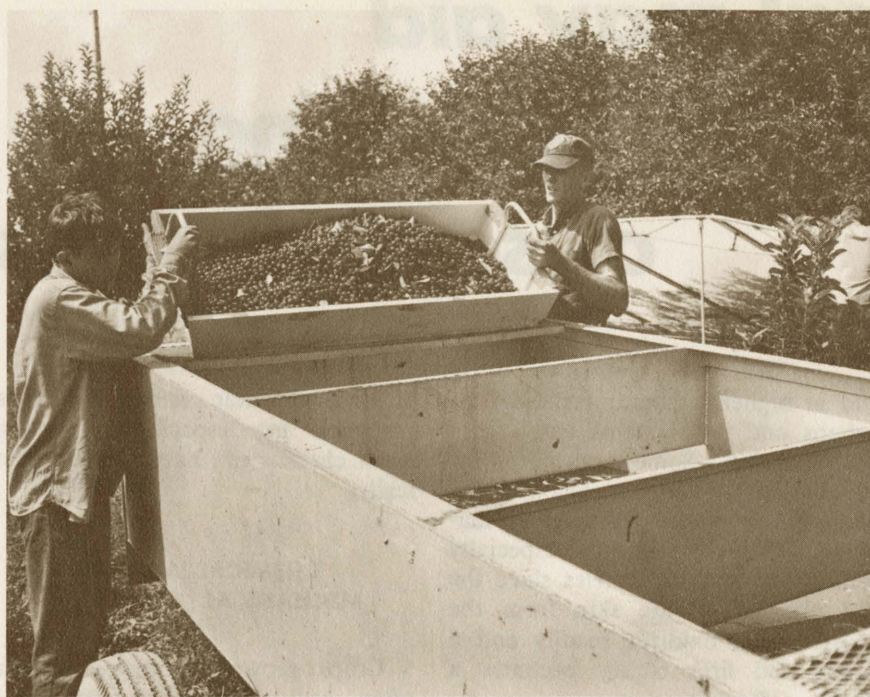
Crops grown for processing are often well adapted to mechanical handling. More than 50 percent of the Montmorency cherries grown in Utah County are now mechanically harvested by shakers. The past abundance of labor at harvest season was drastically reduced when the Bracero program of imported Mexican laborers was terminated. Growers with large acreages then had no practical alternative except mechanical harvesting. In additions, the actual harvest



Figure 1. Closeup of a tractor mounted shaker harvesting sour cherries.

J. LAMAR ANDERSON is an Associate Professor, Plant Science Department, Utah State University, Logan, Utah.





**Figure 2.** The cherries are emptied into a transport tank filled with cold water. This reduces bruising and subsequent scald or browning.

cost of an experienced crew using tree shakers is less than that of picking by hand.

A still - experimental chemical promises to make mechanical harvesting of sour cherries even more efficient. Ethrel (2-chloroethanephosphonic acid) as formulated by Amchem Products, Inc., represents a new class of unusually effective plant growth regulators which produce a variety of hormone-type responses in plants. Plant growth is regulated by the unique chemical structure of these compounds which upon degradation release ethylene within the plant tissues. Depending upon the plant species, chemical concentration, and time of application, the released ethylene produces numerous physiological effects. Various phases of plant metabolism, growth and development are thus subject to deliberate manipulation.

#### UTAH RESULTS

This year Ethrel was applied on an experimental basis by Utah State University personnel to a block of 8-year-

old Montmorency sour cherry trees in Utah county. The trees held a moderate cherry crop. Spray treatments of 250, 500, 1,000, and 2,000 ppm were

applied July 25, 1968. The cherries were harvested with a Friday inertia-type tree shaker 5 days later. The grams of force required to remove the fruit was measured with a Hunter mechanical force gauge.

Cherries on treated trees were appreciably easier to harvest than those on untreated trees. Approximately 5 and 10 percent of the fruit on trees receiving Ethrel at 1,000 and 2,000 ppm, respectively, dropped prior to harvest.

Cherries from treated trees appeared to be more mature and were a darker red than those from untreated trees. Treated fruit was significantly higher in percent soluble solids and color as measured by light absorbance of an ethanol extract.

#### HASTENS RIPENING

The Ethrel treatments apparently increased the ripening rate of all fruit on the treated trees. Fruit from treated trees was no more uniform in maturity than was fruit from untreated trees. Approximately 10 percent of the fruit from comparably mature treated and untreated trees remained



**Figure 3.** The transport tanks are emptied into large holding tanks, also filled with cold water, at the processing plant.



on the trees following mechanical harvesting. Ethrel thus will not produce a more uniformly mature fruit, but it may help growers schedule their harvesting for a more efficient work pattern. A spaced acceleration of fruit maturity, time-controlled by Ethrel treatment, could extent the harvest season.

The 1,000 and 2,000-ppm treatments caused such heavy leaf crop that leaves filled the containers and hindered the shaking operation, al-

though some defoliation had occurred before shaking. These 1,000 and 2,000-ppm rates also caused gum extrusion from the lenticels of treated twigs. Defoliation and gumming were especially severe on weak trees treated at these rates. The 500 ppm treatment is, therefore, tentatively considered the optimum level for use on sour cherries. This lower rate will be investigated further so that definite recommendations can be made when Ethrel is labeled for agricultural use.

## WESTERN X-DISEASE

(continued from page 110)

Experimental studies have shown that top-working sweet cherries on the framework of mahaleb rootstocks, in such a manner that four to six sweet cherry branches develop on separate leaders of the mahaleb, reduces the spread of x-disease virus. With these trees one branch may become infected, but the virus does not move through the mahaleb and infect other branches. The infected branch may be removed and the tree remains healthy. Top-worked trees are useful when natural spread is slow, but if spread is so rapid that several of the top-worked branches become infected at about the same time, the tree cannot be salvaged. Therefore, if top-worked trees are used to control x-disease in sweet cherries, it is essential that infected branches be removed as they appear, to prevent buildup of virus in such trees.

The use of resistant varieties provides a possible means of control in areas where x-disease has become serious. Long Stem Bing and Dicke Braune Blankenburger are resistant to infection and have fairly good quality. However, the quality is not as good as in Bing and Lambert, the common commercial varieties. Black Giant is another variety that has been resistant in greenhouse and field studies. This could be a useful variety for home plantings if free of little cherry virus, another serious virus disease of sweet cherries. Black Tartarian and Burbank appear to be resistant to natural spread in orchards, although they can be infected by budding. These two varieties can be recommended only as pollenizers or back yard trees.

X-disease virus does not persist in the soil, therefore an infected tree can be removed and be replaced with a healthy one. However, we recommend not replanting sweet cherries in an orchard where rapid spread is taking place because young trees are as susceptible to infection as older ones. We recommend planting new orchards as isolated as possible from old diseased cherry trees and from chokecherries.

**Table 1. Influence of preharvest applications of ethrel on Montmorency Cherry maturity and abscission (mechanically harvested July 30, 1968)**

Treatment <sup>a</sup>	Abscission <sup>b</sup> (grams pull)	Soluble solids (per cent)	Absorbance <sup>c</sup> (per cent)
Control	160	13.6	12.5
250 ppm	120	15.5	14.5
500 ppm	115	15.6	12.0
1,000 ppm	78	16.9	14.5
2,000 ppm	88	16.4	16.5

<sup>a</sup>applied July 25, 1968.

<sup>b</sup>values are averages of 10 replications.

<sup>c</sup>50 percent ethanol extract measured with Bechman DU spectrophotometer.



**Figure 4.** Sorters pick out any substandard fruit before the fruit is frozen or canned.



# FARM PLANNING FOR WEED CONTROL

Weed control programs, to be effective and efficient like most other worthwhile endeavors, require knowledgeable planning. A good weed control plan followed in detail can save a farmer money and increase his income.

The high percentage of weedy fields in Utah indicates an urgent need for more effective weed control. If farmers were fully aware how much weeds lower crop yields and farm income, they would probably be more interested in any procedures that would more effectively control weeds.

Much of any county's organized and tax supported weed control work is devoted to the control of noxious weeds along roadways. Certain counties provide some herbicidal spraying service to farmers, and this varies among counties. The spray service to farmers is limited to a few herbicides and is largely routine. The work is done by individuals with little or no

## D. C. TINGEY

training and experience in crop production and weed control, and they are not expected to help farmers plan effective weed control programs.

Effective weed control consists of much more than the occasional spraying with some herbicide. Alternative methods may be combined with different herbicides to accomplish certain objectives. Kinds of crops, crop rotation, tillage practices including cultivation, time of planting, better seed of proven adopted varieties, proper seeding rate, timely burning and mowing, better use of fertilizers and improved irrigation practices are all factors to be considered. These different factors can be combined into an economical and effective method of control for any particular form.

D. C. Tingey is a retired Professor of Plant Science (Agronomy), Utah State University, Logan, Utah.

Most farmers will need some help in planning a good weed control program. Such help should come from persons trained and experienced in soil management, crop and livestock production, farm management, use of herbicides, the growth habits of weeds, and weed control principles.

County agricultural agents, vocational agriculture instructors, and farm planners for the Soil Conservation Service may assist directly or indicate where qualified help can be obtained.

## GOALS IN WEED CONTROL

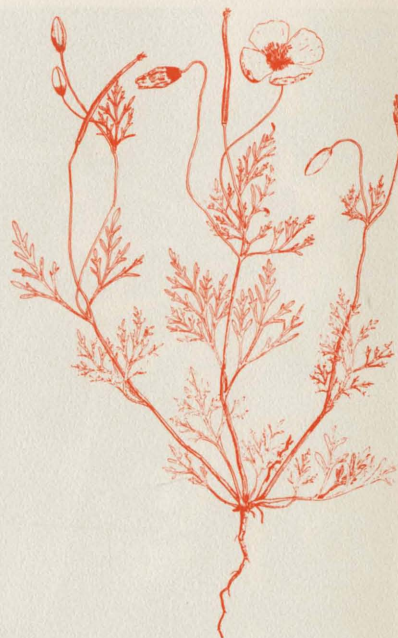
Farmers should set certain objectives to be accomplished in weed control. How near these objectives are achieved will serve as a measure of the success or failure of the farmer's efforts. Three important objectives are: (1) complete eradication of all creeping perennials from farm land, (2) the ultimate elimination from till-



**Figure 1.** Witchgrass or ticklegrass, *Panicum capillare*. This drawing shows the annual growth habit of the grass.



**Figure 2.** Pigweed or redroot, *Amaranthus retroflexus*, a weed common to irrigated fields throughout the state.



**Figure 3.** Roemeria poppy, *Roemeria refracta*, is an abundant weed in grain fields in Box Elder and Cache counties.



able land of all weed seeds which have short viability spans in the soils, and (3) the reduction to a minimum of the annuals and biennials whose seeds persist in the soil for long periods of time.

Admittedly, these objectives are idealistic and few farmers will meet all of them, but they are goals to work toward.

To accomplish these three objectives an operator needs to prevent weeds from producing seeds on the farm and avoid weeds being introduced to the farm. Most weeds grow from seeds produced on the farm.

### GENERAL ITEMS TO CONSIDER

A plan should include the entire farm — tillable and non-tillable land, waste land, fence lines, ditch banks, roadways, parkways, and land adjacent to farm buildings. The plan should fit the particular farm and type of enterprise. Weed control plans can be adapted to any type of farm enterprise, although some provide more flexibility and effectiveness than others.

Weed control on dry land farms pays real dividends because it saves the limited moisture which can then be conserved for the crop. The present wheat allotment program and the practice of alternating wheat with fallow coupled with fall planting provides ample opportunity to control weeds. The control procedures should be kept simple and most of it may be accomplished by tillage, certain herbicides, and planting uncropped areas to grasses.

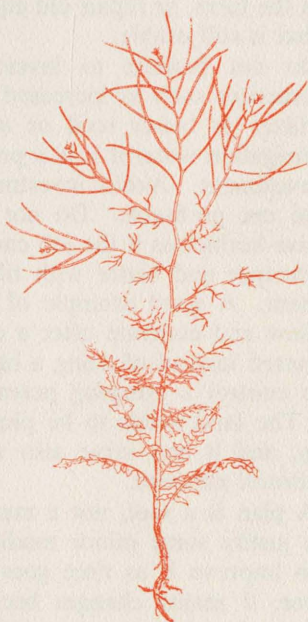
Under more diversified irrigation farming, weed control may be a little more complicated. Besides tillage and herbicides, it is possible to utilize different crops and cropping programs and other indirect control measures. The returns per acre are high and will justify practices not practical under low-acre return. Spot infestations likewise may justify a practice that would not be workable or practical on large infestations.

Weed control in high mountain meadows requires still a different approach. Crop diversification is markedly limited, and tillage may only be

practiced to a limited extent, if at all. Much of the weed control must be accomplished through good management of the meadows. Primarily this involves proper grazing, timely mowing, and use of herbicides. Since there are numerous conditions and weed problems under the different types of farming, each farm requires special planning if weed control is to be most effective. Often a change in the farm enterprise or cropping practices can provide solutions to some of the most serious problems and at the same time increase the net farm income.

Wild oat is one of the most troublesome weeds in Utah on irrigated farms. This weed is largely perpetuated in spring sown small grains or crops where annual seed production is permitted. Fall instead of spring planted grains would do wonders in helping to control wild oats and many other weeds. Also forages, such as alfalfa and pasture coupled with timely mowings to prevent wild oat seed production, can soon solve this common problem.

Erect red roots, lambsquarters, wild mustard, sweet clover, barnyard



**Figure 4.** Jim Hill mustard, *Sisymbrium allissimum*, is found in grain fields, cultivated ground, and waste places.



**Figure 5.** Puncture vine, *Tribulus terrestris*, is a troublesome annual weed prevalent along roadsides, railroad right-of-ways, and is often found in orchards and hay fields.



**Figure 6.** Showy milkweed, *Asclepias speciosa*, is a familiar sight along fence rows, ditch banks, and roadsides.



grass, and many others are serious problems in annual row crops such as sugar beets; yet they present little or no problem in spring or fall sown grains where timely applications of 2, 4-D are made. This herbicide does not control barnyard grass, but the seedlings emerge late in the spring and shading by the grain crops will control it.

### INCREASED INCOME

The first and most important factor to strive for in weed control is to increase the net farm income and second to control weeds. It is usually not difficult to increase farm income where weeds are a problem. This can be accomplished by growing more profitable crops yet equally effective or more so in weed control, and general upgrading of farm practices. This includes increased use of the right kind of fertilizer, good seed of proven varieties, better use of irrigation water, more timely planting of crops, and proper tillage combined with the proper use of herbicides.

### SPECIFIC LIST OF ITEMS

1. Make a rough outline map of the farm and indicate fields, fence lines, ditches, roadways, etc. Identify each area by a numbering system which can serve as a future reference to any given area.

2. List the weed species involved and the extent of the infestation on each field, fence line, ditch bank, etc. Critical problems involving creeping perennials could be indicated by location on a second sketch of the farm. This second map could also serve to locate new weed infestations and would be useful as a guide when the farmer is out in the fields making treatments.

3. Type of enterprise: (a) livestock and kind of each, (b) general farming, (c) vegetable farming, (d) fruit farming, (e) production of certified seed, and (f) combinations of these different types.

4. Crop and acreage of each grown on the farm.

5. Other crops that are grown in the area.

6. If it is a livestock enterprise, are the crops grown the most suitable? If it is not a livestock enterprise, are the crops the most profitable that can be produced?

7. What is the fertilization program for the farm?

8. Is water available for all the land throughout the season?

9. Are the crop varieties grown on the farm those recommended by the Agricultural Experiment Station?

10. What has been the source and quality of the seed used? Crops seeds may be one important source of weed seed on the farm, and, if such is the case, then by all means obtain only the best quality seed for planting. If one is unable to identify weed seeds, then plant only seed that is tagged and stated to be free of weed seeds or better still, plant only certified seed.

11. Time of planting of many crops is important and one should be sure that the various crops are planted at the most opportune time.

12. Is the farm broken up into many small fields that might be combined into fewer larger ones? Are there obsolete irrigation ditches, fences and waste areas that might be dispensed with and added to the tillable land?

13. The farm operator must assess his own attitude and interest in weed control. Unless he is willing to carry out the details of the program, all the time put into it will be futile.

### GROUP AND INDIVIDUAL PLANNING

In the initial stages of weed control planning, the advisor may work with groups of farmers. In group meetings one can lay the foundation for farm planning. The main objectives and items must be considered. Some farmers in each area throughout the

state are doing a good job of weed control and these should be urged to attend the planning meetings and share their experiences. Certain individuals may present their plans to the entire group for criticism and discussion. Each farm plan should be reviewed by the advisor to be sure it is workable and effective. All plans, suggestions, and recommendations should be included in writing. Both the farmer and farm planner should have a copy.

It would be highly desirable to hold group meetings periodically and discuss programs, problems, revisions needed and to have certain farmers indicate the progress they have made.

### ADVICE FOR A GOOD FARM PLAN FOR WEED CONTROL

1. Most any plan is better than none at all, but strive to get the best workable plans for each farm situation.

2. Keep the plan simple, inexpensive, workable, but above all — effective.

3. Make use of equipment available on the farm, or repair old equipment that is still usable.

4. Do not hesitate to invest in some practices such as increased use of fertilizer or better seed or additional irrigation water if it is a profitable investment. Avoid investments that are not profitable. Do not use expensive herbicides if the job can be done cheaper and better with tillage equipment. A good example of this is to plow and cultivate after a crop is harvested instead of using a herbicide to control a creeping perennial weed. The land needs to be plowed anyway, and it can serve also as a weed control measure.

5. A plan is a tool, not a master. It may justify some minor modifications to improve it as time goes on. However, if major changes become necessary, the plan was not good in the beginning.

For a comprehensive description of weeds common to Utah, order *Weeds of Utah*, by Arthur Holmgren, 1958. Utah Agr. Exp. Sta. Spec. Rep. 12. Logan. 85 pages. The cost is 50 cents.



# Exotic game birds in Utah's future

WAYNE H. BOHL and LOIS COX

In the September issue of *Utah Science* we described the purpose and general operation of the Foreign Game Investigation Program (FGIP), which is financed largely by the arms and ammunition excise tax. As a cooperative effort between Federal and State agencies, the FGIP is designed to provide alternatives to vanished or vanishing species of U.S. game birds. The two biologists employed by the FGIP respond to specific requests from participating state fish and game departments.

## PRELIMINARIES TO PURSUIT

Each response begins with a literature survey that often involves the Library of Congress and the Smithsonian's extensive collection of information on birds of the world. The resultant detailed descriptions of vegetation, climate, geology, and the ecology of specific birds, plus post reports from relevant U.S. embassies, provide a basis for deciding whether a trip overseas is warranted. If the decision is for an on-the-spot program, one or both of the FGIP biologists proceeds to learn the basic vocabulary of the country to be visited.

The scientists have found that knowing the Latin names for plants and animals, along with from 200 to 400 key words of the native tongue, permits a reasonably satisfying life abroad. At times even fewer words suffice, as was discovered in Japan among a group of hunters (perhaps, hunters "speak" an international language?). Even so, guides or interpreters are often essential during the first weeks in a foreign country until

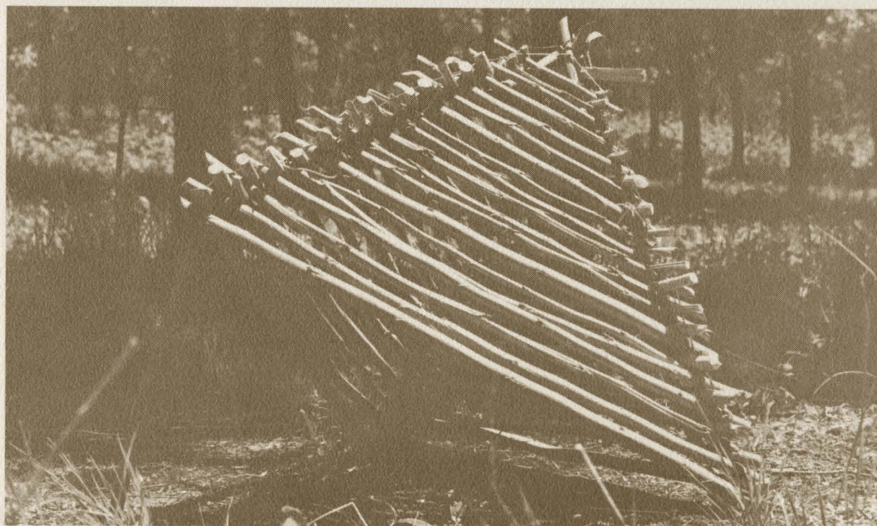
a basis can be laid for smooth-running studies, and the biologist has mastered the local road system and access routes.

Besides learning the rudiments of the language, the preliminary preparations include giving thought to feeding and caring for any birds that are captured. Alfalfa is an excellent source of vitamins and protein for the birds, so the FGIP personnel must be

prepared to "grow their own" if it isn't common to the area. Cooked, powdered beef liver can generally be purchased locally to provide the birds with additional protein. Almost always, certain medicines and supplements such as vitamins A, D<sub>3</sub>, C, and K will be unavailable or prohibitively priced overseas. Such items must be carried along.

WAYNE H. BOHL is a Research Biologist in the U.S. Fish and Wildlife Service, Division of Wildlife Research. He is stationed at Utah State University as a member of the Foreign Game Investigation Program. LOUIS M COX is Technical Writer for the Utah Agricultural Experiment Station and Division of University Research.

EDITOR'S NOTE: Thanks for the use of the Afgan white-winged pheasant photograph used for the cover of September's *Utah Science* is given to the New Mexico Department of Game and Fish.

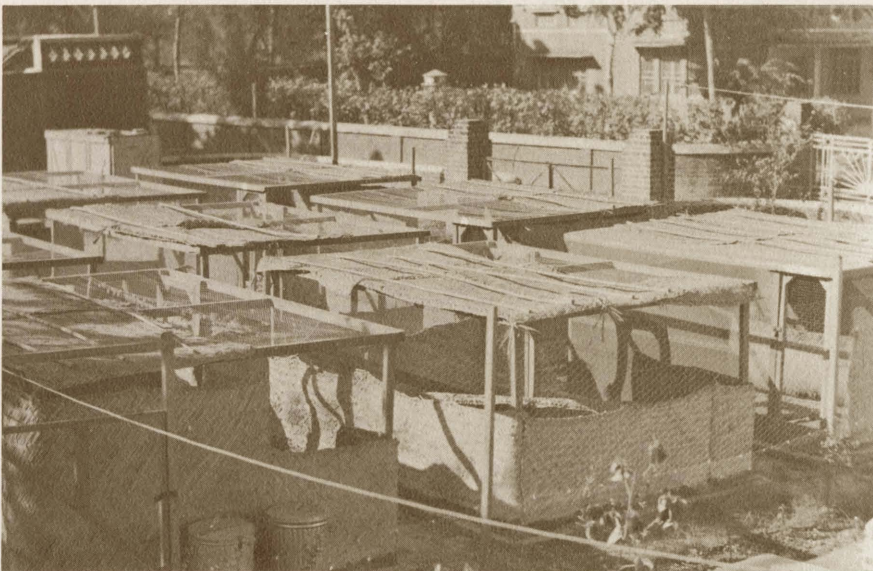


**Figure 1.** This inexpensive Argentine trap constructed by country people is designed to catch one or two birds at a time. The bait under the trap is grain, and birds entering trip the single collapsible post, which is tied to string stretched over the ground. Horse hair snares (nine strands together with slip knot) are also commonly used to trap tinamous in Argentina and Chile.





**Figure 2.** The cannon net trap was used occasionally for FGIP ducktrapping work in Argentina. The net is projected over birds that have been enticed to the area by being baited with grain or water. Photograph shows a cannon trap netting Rio Grande turkey in northeastern New Mexico.



**Figure 3.** FGIP pens for collected game birds in India. Such pens can hold 75 to 100 francolins or far fewer of the larger-sized red junglefowl and Kalij pheasants. Some pens have wire floors to prevent birds from eating droppings which may contain disease organisms. People working around the birds must have different shoes for entering each pen. Such precautions help break any disease cycle that might pass from one pen to the next. A 60-day quarantine is standard requirement before birds can be shipped overseas to the United States.

Transportation can be a major problem in countries where cars are a rarity and roads may be ephemeral. Expedition planning, therefore, generally includes arranging to bring along enough jeep spare parts to permit practicing preventive maintenance for 2 to 3 years. During the last 5½ years, the two FGIP jeeps traveled a total of 322,000 miles in India, Pakistan, Afghanistan, Argentina, and Chile.

#### FROM HERE TO THERE

Some of the miles are accumulated in the process of evaluating the potentials of certain birds for successful releases in the U.S. The rest are added during capture operations and in transporting eggs or birds to their point of departure for the U.S.

The environmental conditions in different countries and the characteristics of specific birds dictate capture



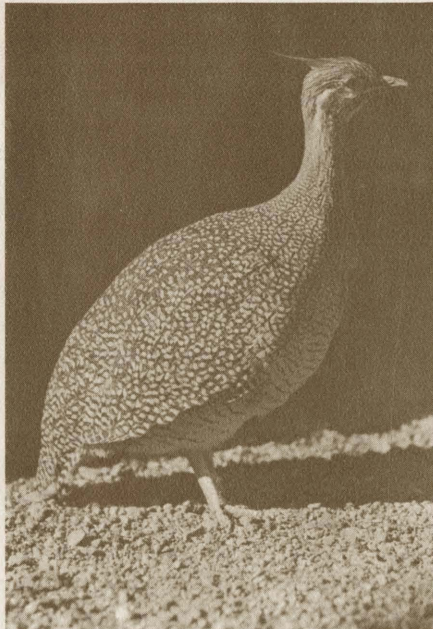
methods (figures 1 and 2). Sometimes chicken eggs can be bartered for wild game eggs. In some cases eggs or young can be purchased with local currency.

If birds rather than eggs are collected, they are held in isolated quarantine for 60 days before starting their trip to the U.S. (figures 3 and 4). The holding compounds must be guarded around the clock every day against such animated sources of trouble as cats, stray dogs, snakes, and small rodents. If any of these creatures get close to the holding pens, the birds are likely to flush wildly. While rarely fatal, such panic flights may leave the birds "scalped" and not fit for overseas shipment.

Getting birds or eggs from a holding area to a major airport can be an adventure. Moving eggs or young



**Figure 4.** Native trappers bring birds to FGIP personnel in all types of containers. Wicker cages are seen here with chukars; in other instances birds are carried in gourds with air holes or in covered round grain or powder sifters.



**Figure 5.** The crested tinamou, a South American game bird about the size of a hen pheasant, thrives in arid to semi-arid brushlands, often with no direct water available. Their food is mainly vegetable matter plus some insects. Rainfall in good habitats varies from 4 to 15 inches annually, falling predominantly in the spring, summer or winter months. Roosting is on the ground, in a bowl dug by each bird with feet and body motions.



**Figure 6.** This example of prime brushland habitat of the crested tinamou in Argentina may be matched in southwestern deserts and Great Basin brushlands. Creosote bush occurs throughout most of the Argentine brushlands and is found in North American deserts. From 5 to 8 percent of the annual diet of crested tinamous is comprised of the seeds of creosote bush. No native United States game birds include this seed in their diet.





**Figure 7.** The pale spotted tinamous of Argentina thrive in grasslands and do not need agriculture if sufficient grasses are present. They will utilize some grain fields as well as forbs found in fallow fields. Grain is not effective in baiting traps, so most tinamou trapping has to be done with horse-hair snares placed in daily movement paths.

birds is especially difficult since these cargoes are often supremely susceptible to extremes in weather. Trial and error are the usual teachers. For example, a previous mishap contributed to the well being of young seese partridges in Afghanistan. The FGIP personnel learned from experience that wet sand in the bottom of shipping crates was necessary to prevent dehydration in such birds during the 15-hour trip over the Hindu Kush Mountains to Kabul.

In one case in Chile, ready-to-hatch eggs had to be carried in a jeep for 6 hours. The solution was an incubater (run off of a 12-volt inverter) that could be balanced between the driver and his passenger. The trip began with 87 eggs and ended with 75 eggs and 12 chicks, while the other eggs hatched a few days later.

Another time, 3 to 4-week-old young birds in one country were ready to ship to the permanent FGIP holding pens, which were in a neighboring country. Snarled red tape dictated that the birds would have to travel approximately 12 hours by

truck over rough Andean roads rather than by air. Ultimately, the birds had to be caught one day at 3 a.m., without the convenience of electric lights, and driven to the local bus depot where drivers of small cars and trucks congregated. These men then had to be persuaded to carry the crated birds to the holding area.

## OUTLOOK FOR UTAH

The high plateaus and mountains of Utah and her neighboring states tend to have more freezing temperatures and heavier snowfalls than the areas in which FGIP personnel have been able to operate. Until budget problems are resolved and permission is granted to send biologists to Russia or similar cold and snowy zones, it will be difficult to recommend suitable exotic game birds for major portions of Utah, Idaho, Nevada, Montana, Wyoming, New Mexico, Colorado, and Arizona.

FGIP work in Argentina from 1964 to 1967, however, disclosed two game birds that seem to hold special promise for bolstering at least some of Utah's hunting potentials. The crested tinamou is a brushland species (figures 5 and 6), while the pale spotted tinamou prefers grasslands (figures 7 and 8).

Suggested boundaries of likely release areas in the U.S. will depend largely upon habitat characteristics, precipitation, and temperature patterns. Figure 9 was specifically drawn to show the climatic potential for crested tinamou, but for southern states with grasslands it is also generally applicable for the pale spotted tinamou.

Other South American tinamous contemplated for possible release in western United States include: the large brushland species (figure 10); the canyon tinamou (figure 11); and both Chilean subspecies (figure 12).

Among tinamous it is normal for the male to assume responsibility for hatching the eggs and raising the young. The male crested tinamou



**Figure 8.** Substantial populations of pale spotted tinamous in Argentina are found in rainfall zones of 5 to 22 inches. Colorado and Utah are experimenting now with building up production of this fine game bird for release in their grasslands. Dogs are almost a must to flush or hunt tinamous.



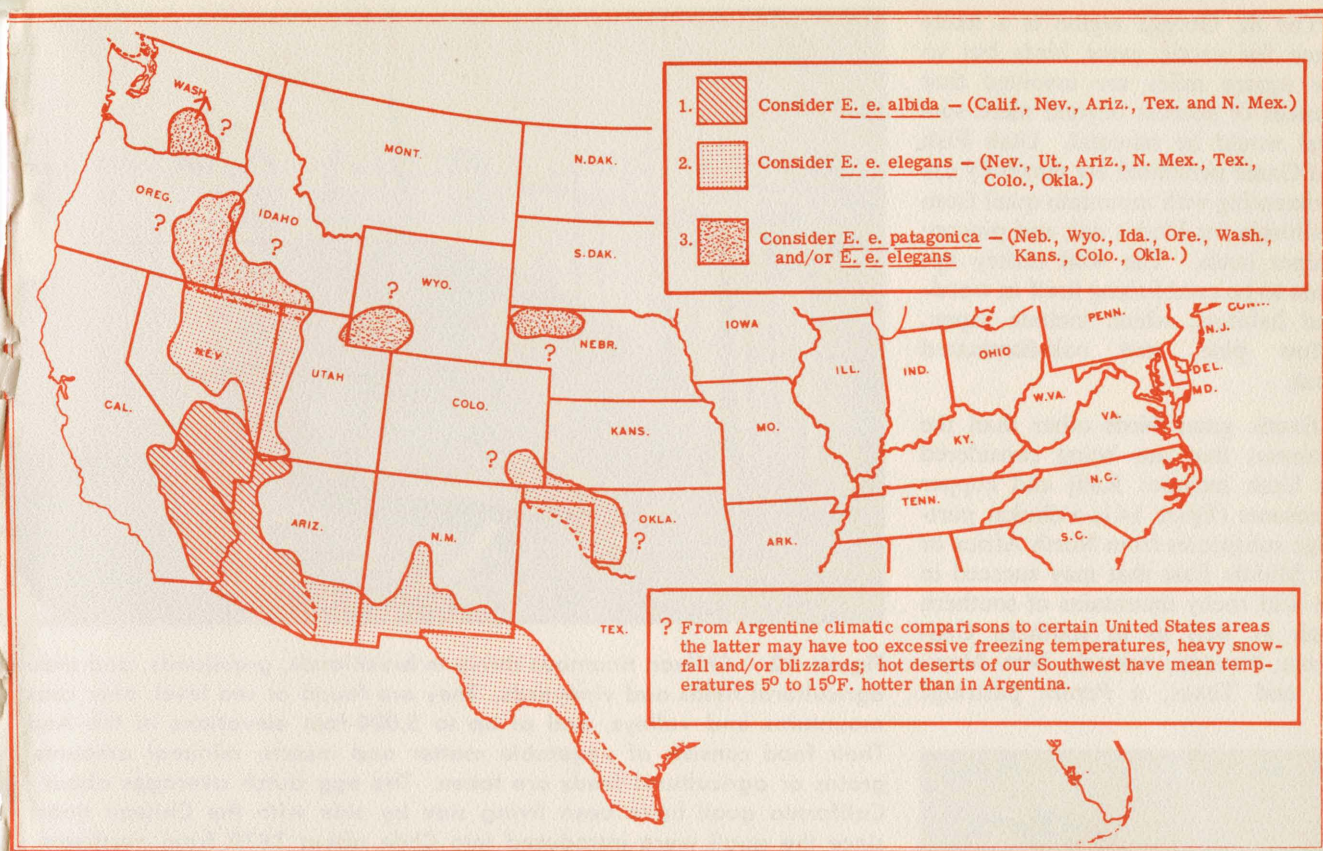


Figure 9. Selected climatic regions of the United States considered for crested tinamou experimental liberations.



Figure 10. Large brushland tinamous inhabit the most dense of brushy areas, thriving in the warmer woodland areas of Argentina. The pound-sized tinamou is shy, and holds well for pointers. An average clutch is 10 to 11 eggs. Their food consists of vegetable material and they take more insects than do many other species of tinamous. They roost on the ground in self-dug shallow bowls.

shown in figure 13 is incubating an incredible clutch of 26 eggs.

Adult female crested tinamous remain separate after the eggs are laid until the fall and winter months, when they once again flock with the males and the year's crop of young birds.

#### BEYOND TINAMOUS

The moisture and vegetation limitations inherent in Utah's prevailing habitats severely restrict possibilities for bird populations. Much of western Utah contains little readily available water. Extensive areas of the state are characterized by alkaline soil that supports only sparse vegetation or vegetation that is of little variety. Creosote bush, saltbrush, or black brush in pure or mixed stands with little understory offer meager supplies of food for game birds. Sagebrush often forms almost pure stands with little understory vegetation.

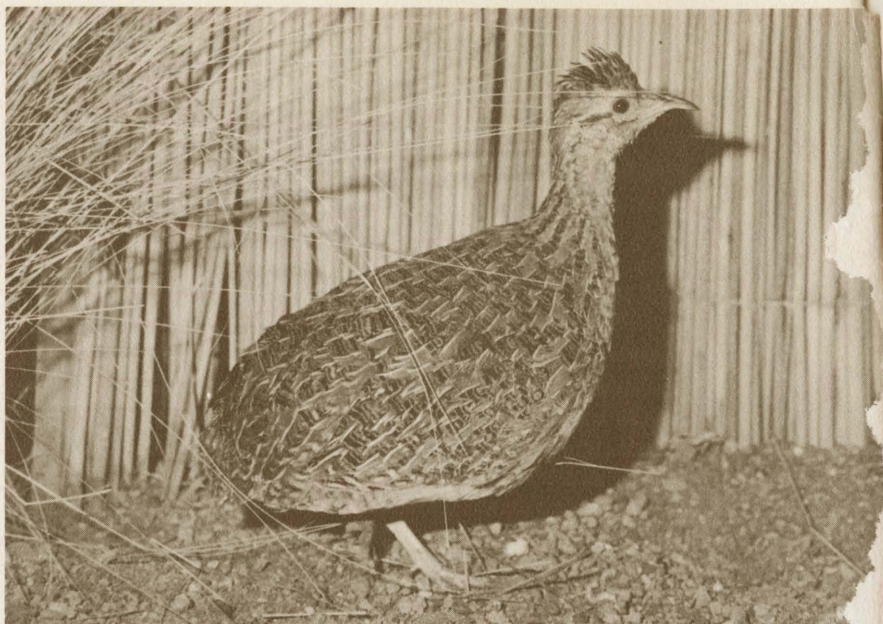


The St. George region is a likely home for exotic game birds but so few square miles are involved that chances of success beyond mere survival would be minimal. Utah Fish and Game personnel are currently experimenting with mountain quail from California for Utah's oak and pinyon-juniper lands. The wild turkey appears to be establishing itself in woodland habitats, which include aspen, yellow pine, and oak-dominated areas.

Exotic game birds other than the tinamous that are being considered for Utah include: Kalij and copper pheasants (figure 14); a chukar partridge subspecies from North Africa or the Middle East that may succeed in the arid rocky mountains of southern Utah as well as in southern California, Nevada, Arizona, New Mexico, and Texas; a *Perdix* partridge



**Figure 11.** Canyons in the Andes are the habitat of this very shy bird. The canyon tinamou represents a new subspecies for the genus, discovered and documented by FGIP personnel during their recent south American studies. These birds are almost impossible to flush from the brushy canyon bottoms without the help of a dog. They eat mainly vegetable materials. Their egg clutches vary from 4 to 10 eggs per nest, and they roost on the ground.



**Figure 12.** Chilean tinamous thrive in brushlands, grasslands, and around agricultural fields and vineyards. They are found at sea level, over coastal mountains and valleys, and at up to 5,000-foot elevations in the Andes. Their food consists of vegetable matter and insects; minimal amounts of grains or agricultural feeds are taken. The egg clutch averages about 5 to 7 eggs. California quail have been living side by side with the Chilean tinamou since the quail were introduced into Chile about 1879 from northwest California stock.



**Figure 13.** Male tinamous incubate the eggs and brood the young. Here, a male reared on a private game farm is attempting to incubate 26 eggs which the female insisted on laying. This is far beyond the normal wild clutch of 5 to 7 eggs per nest. Most of the eggs being incubated by this male dried out, and almost none of them hatched young that lived very long. Male crested tinamous, given proper cover and privacy in pens, can consistently raise two or three broods a year; a feat that neither male nor female partridges, francolins, quail, grouse, and pheasants accomplish very often.



from Turkey or southern and central Asia; and semi-migratory Imperial Wood-grouse (a 1-pound bird) from Turkey and southern Russia east to the Thar desert of India. All of these birds have been surveyed by the FGIP, either through literature searches or limited field work, but further detailed research must precede any specific recommendations.

Twenty years of FGIP research have produced some tangible benefits and have laid the solid basis for future progress. The estimated 15 to

20 million exotic game birds being harvested today in the United States are eloquent evidence of the potential value of game birds from foreign lands. The FGIP's patient, ecological approach to locating new game birds is certainly proving to be the most effective method for the long run.

As cooperating state game departments spend more time in conducting detailed follow-up studies of introduced species, future scientific importations of exotic game birds will be even more likely to succeed.

## CAECAL WORM MAY CAUSE CHUKAR LOSS

Pheasants can carry a double load of trouble to turkey farms and chukar partridge ranges. The trouble is the caecal worm. This intestinal parasite besides inflicting direct harm also carries a protozoan that causes blackhead disease, says Dr. Everett E. Lund, a parasitologist in USDA's Agricultural Research Service, Beltsville, Maryland.

The earthworm is the intermediate link between domesticated and wild birds for caecal worm infection. Earthworms pick up caecal worm eggs from the droppings of one bird, and the eggs hatch into larvae that remain inside the worm until it is eaten by another bird.

Pheasants pose a special hazard because they usually withstand blackhead, yet their droppings often contain blackhead-carrying caecal worms. Since pheasants range over major U.S. turkey-producing areas and often visit turkey runs, they may be major carriers of the disease. Dr. Lund suggests that an early study be made on the extent of this problem.

Dr. Lund added that the earthworm-blackhead link may be one reason chukar partridges haven't done so well in most areas of the United States after their introduction from Asia. When Dr. Lund exposed chukar partridges to earthworms, he found that 70 to 75 percent of the birds were infected with a clinical case of blackhead. About 64 percent of the chukars died — showing they're fully as susceptible to blackhead as turkeys.

While the direct relationship between blackhead disease and pheasants and chukars remains to be established in the wild, circumstantial evidence supports Dr. Lund's belief that blackhead is an important factor for the chukar's limited range. Only in arid climates, where earthworms are few, have chukars become established in significant numbers, Dr. Lund said.



**Figure 14.** Copper pheasants (top) and Kalij pheasants (bottom) inhabit woodlands in the canyons and mountains of Japan and India. One or both of these fine game birds might fit into similar habitats of Utah. Their food consists of vegetables and insects; neither needs agriculture. Both roost in trees at night.



*Forster*  
Director

Publication:  
**UTAH SCIENCE**

POSTAGE PAID  
U.S. Department of Agriculture



Form U. Q. Permit 1142

POSTMASTER: Please return if unclaimed

## APPLE PRODUCTION IN NORTHERN UTAH

(continued from page 107)

Utah than in some of the main Northwest apple growing areas. Hence, production costs should be lower because less orchard heating is required.

### SUMMARY

Although the Northwest growers are planting a large number of trees, it seems that Utah growers are in a good position to extend their acreage and still have a market for their apples.

**Table 7. Suggested apple planting distances given in feet \***

Tree size	Original planting		Fillers removed	
	Distance between trees	Number of trees/acre	Distance between trees	Number of trees/acre
Square System				
Semi-standard	12.5 x 25	139	25 x 25	70
Spur	10 x 20	217	20 x 20	108
Semi-dwarf	10 x 20	217	20 x 20	108
Dwarf	Not recommended			
Rectangular System				
Semi-standard	15 x 20	145	20 x 30	73
Spur	15 x 20	145	20 x 30	73
Semi-dwarf	12.5 x 15	232	15 x 25	116
Dwarf	8 x 16	340	No removal	
Hedgrow System				
Semi-standard	10 x 20	108	No removal	
Spur	12.5 x 25	139	No removal	
Semi-dwarf	10 x 20	217	No removal	
Dwarf	4 x 16	681	8 x 16	

\*Taken from an unpublished manuscript by John C. Snyder, Washington State University, Pullman.

# UTAH AGAIN FREE FROM HOG CHOLERA

Utah has regained its "hog cholera free" status, the U.S. Department of Agriculture reported on November 1.

Utah was officially declared "hog cholera free" on Feb. 9, 1966, but lost that status a year ago because of a hog cholera outbreak which spread to other farms within the State.

To be declared "hog cholera free," a State must carry out all the steps in the 4-phase eradication program being waged by USDA's Agricultural Research Service and the States in cooperation with the swine industry. In addition, there must be (1) no outbreaks for at least 1 year, and (2) no living vaccines used for at least 1 year. If a State loses "free" status, it must go for another year without an outbreak before it again qualifies as "hog cholera free."

With Utah, there are now 10 States which are "hog cholera free." They are Alaska, Idaho, Michigan, Montana, North Dakota, Oregon, Washington, and Wyoming. Forty States are now in the final "stamping out" phases of the eradication program.

The target date for a "hog cholera free" United States is 1972.

## WILDLIFE NOTES

Deer fawns are quiet little creatures that rarely make any noise while hidden by their mothers. However, twin fawns hidden in thickets may "talk" to each other in tones that sound like the soft calls of catbirds.

Although a buck deer ignores his fawns, a fawn may sometimes be seen "hero worshipping" a big buck — following him, imitating him, or just staring at him in what might pass for amazement.

Rabbits (such as cottontails) are born in nests, and are blind, naked and helpless at birth. The hares (such as jackrabbits) are born well-furred, wide-eyed, in the open, and able to travel.